Discovery—September, 1935
PERIODICAL ROOM
GENERAL LIBRARY
UNIV. OF MICH.
BRITISH ASSOCIATION ADVANCE NUMBER

DISCOVERY

A Monthly Popular Journal of Knowledge

September 1935 One Shilling

IN THIS ISSUE

SEP 11 1935

Racial Myths & Ethnic Fallacies

By Dr. A. C. Haddon and Dr. J. S. Huxley

◆

Science and the Fine Arts

By Dr. P. D. Ritchie

◆

Television and the Future

By H. Warren

◆

Professor W. W. Watts on the Norwich Meeting of the British Association

◆

ALSO

The Costly Nematode — Lost Tribes of Malaya — The Ruins of Quiriguà — Joseph Hooker and the British Association

Williams & Norgate

Epidemics and Crowd Diseases

By MAJOR GREENWOOD, D.Sc., F.R.C.P., F.R.S.,
Prof. of Epidemiology & Vital Statistics, London University.

"Must interest and absorb any student of human life . . . should rank high among those which have attempted to convey to the layman something of the romance of medical research and of medical history."—*Times Litt. Supp.* 21s. *net.*
Charts and Diagrams.

Philosophy and Modern Science

By PROF. H. T. DAVIS.

The book sets forth as simply as possible the basic postulators of physics and traces their implications. The philosophical aspect of the problems has been constantly emphasised. 15s. *net.*

Primitive Art

By FRANZ BOAS.

The standard work by the leader of the well-known Jessop expedition in which the writer discusses in detail and with many illustrations the nature, significance and effect of the earliest art forms. 27s. *net.*

36 Great Russell Street
London

F. H. effected in 1882 a policy with the "Old Equitable" for £500 payable at his death, which occurred in 1933 at the age of 73. The Society paid £1,469 while the total premiums received were only £578.

The Equitable Life Assurance Society

(founded 1762)

19, Coleman Street, London, E.C.2.
W. Palin Elderton, Actuary and Manager.

No shareholders No commission

TAXIDERMY ENTOMOLOGY

Every description of Taxidermist work undertaken. Skins and Furs dressed and mounted as Rugs. Heads and Horns preserved, modelled and mounted as shields.

BEST WORK. KEENEST PRICES.

Apparatus and Books of every kind for Entomology, Botany and Oology supplied.
Full Catalogue post free on request.

WATKINS & DONCASTER
36, STRAND, LONDON, W.C.2.

HUMATAGRAPH

HYGROMETER indicates the humidity of the air with scientific precision. Many forms of illness are aggravated if not caused by damp rooms, damp beds, etc. Models for home and industrial purposes.

Mat Black **25/-** Chromium plated **28/-**

Pocket Model in case **14/6**

From your dealer or direct from the manufacturers.

C. L. BURDICK MFG. CO.,
40-44, HOLBORN VIADUCT, LONDON, E.C.1

•we can now

truly say we are the complete printers, we have always executed high-grade Letterpress printing of every description and now the new Lithographic Section of the Crescent Works is at your service! Unless you have had personal experience you have no idea of the wonderful results obtainable by the process of Lithography, let us show you better printing in monochrome or brilliant multi-colours

BOBBYS *of* MARGATE
Lithographic and Letterpress Printers
UNION CRESCENT, MARGATE
Telephones - - Margate 120 *and* 1402

COLLECTING APPARATUS

Botanical Vascula, Presses, etc. Geological Hammers, Glass Top Boxes, Entomologists' Nets, Pins, Store Boxes, etc.

Write for Catalogue **CY** *Post Free*

Established 1901

FLATTERS & GARNETT, LIMITED
Scientific Instrument Makers
309 OXFORD ROAD, MANCHESTER, 13

NOW! NATURAL COLOUR PHOTOGRAPHY

NATURAL colour photography is now available to all photographers without the use of special apparatus and at very little extra cost. Dufaycolour Roll Films and Film Packs are as simple to use as ordinary films, yet without the use of special filters they produce transparencies in beautiful natural colours. On sale at all approved Ilford dealers.

DUFAYCOLOR

FILM PACKS AND ROLL FILMS

Sensitized and sold by ILFORD LIMITED, ILFORD, LONDON

BEDFORD COLLEGE FOR WOMEN

(University of London)

REGENT'S PARK - - N.W.1

For Resident and Day Students

Principal :

Miss G. E. M. JEBB, M.A.

Degree Courses in Arts and Science
Course of Training in Social Work

SESSION 1935-36
begins Thursday, 10th October.

Prospectus Free on application to the Registrar.

OLIVE E. MONKHOUSE,
Secretary.

Westfield College
UNIVERSITY of LONDON

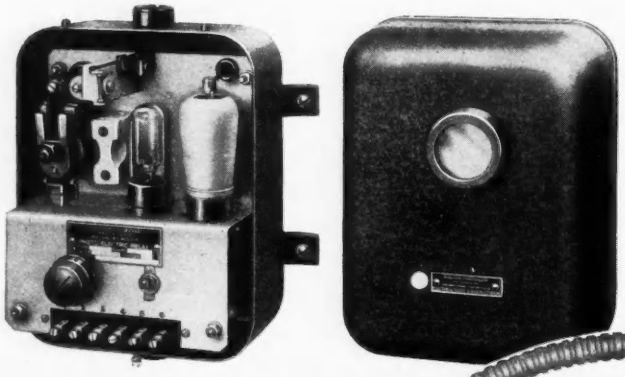
Students are prepared for the Arts and Science Degrees of the University of London. TWO SCHOLARSHIPS of £80, ONE of £60, TWO of £50, and EIGHT smaller SCHOLARSHIPS and EXHIBITIONS will be awarded on the results of an examination to be held in February, 1935. Also a LEVERHULME SCHOLARSHIP of **£100** a year for 3 years.

For further particulars apply to

The Principal's Secretary
Westfield College, N.W.3

B T-H

PHOTO-ELECTRIC RELAY



for "ON" or "OFF" control of A.C. & D.C. circuits of ANY POWER

The most convenient and easiest form of control for many industrial processes and a reliable safety device for man and machine.

ACTUATED BY A BEAM OF LIGHT

—being used for such operations as:—

Counting
Grading
Inspecting
Controlling
Measuring
Sorting
Regulating
Indicating
Weighing
Levelling

EXTREME SENSITIVITY!

Standard Relay responds to the incidence or interruption, of a beam of light, lasting $\frac{1}{10}$ second. The intensity of illumination may be as low as 1 foot-candle.

Write for Descriptive List 5859-I

For ALL Electron Tube Devices including Photo-electric Cells, Thyratrons, and Rectifying Valves *CONSULT* —

BTH RUGBY

THE BRITISH THOMSON-HOUSTON COMPANY LIMITED, RUGBY, ENGLAND

A 1906

FROM **MURBY'S** LIST.

THE DORSET COAST
A GEOLOGICAL GUIDE.
By **G. M. Davies, M.Sc., F.G.S.**
Fully illustrated with photographs maps and diagrams. *Just published.* Cloth 6*s. net.* Also in two parts in paper covers: Western Section 2*s.* 6*d. net.* Central and Eastern Sections 3*s.* 6*d. net.*

EARTH-LORE: GEOLOGY WITHOUT JARGON.
By **Professor S. J. Shand.** 5*s. net.*
For those who wish to learn something of the significance of present-day Geology.

USEFUL ASPECTS OF GEOLOGY
By **Professor S. J. Shand.** *2nd Edition, Revised* 1934. 6*s. net.*
An introduction to the practical aspects of Geological Science.

THE DINOSAURS
A SHORT HISTORY OF A GREAT GROUP OF EXTINCT REPTILES.
By **Dr. W. E. Swinton**
of the British Museum. 15*s. net.*
With numerous illustrations by Vernon Edwards and the author. Readable yet authoritative.

Photographs of Dinosaur models, Lantern Slides and Plaster Casts.
Send for Murby's List of Models of Geological Subjects.

THOMAS MURBY & Co., 1 Fleet Lane, London, E.C.4

SCIENTIFIC BOOKS

New and Second-Hand

Scientific Lending
LIBRARY

Annual Subscription:
Town or Country, from **One Guinea.**
Prospectus on application.

Send for Catalogues, stating interests.

H. K. LEWIS & CO LTD.
613 Gower Street, London, W.C.1
Telephone: Museum 7756 (3 lines)

Just Published

PRACTICAL EVERYDAY CHEMISTRY

By H. Bennett.

How to make what you use

In this great new book you have at your finger-tips page after page of tested recipes for making hundreds of useful products for your own use or for profitable resale. Absolutely up to date, thoroughly comprehensive, and specially arranged for rapid reference, it is, undoubtedly, a miracle of value. It is a book which is bound to have a big appeal for the manufacturer, the chemist, and the student, as well as for the home handyman.

Adhesives, Bleaches, Drugs, Varnishes, Fireworks, Inks, Perfumes, Paints, Beverages, Cosmetics, Dyes, Antiseptics, Fertilisers, and over 2000 other recipes.

Price 10/- net.

Of all booksellers or direct from:

W. & G. FOYLE LTD.
119-125 Charing Cross Road, LONDON, W.C.2
Telephone Gerrard 5660 (10 lines).

A Pictorial Review of Prehistoric Life

BEFORE THE DAWN OF HISTORY

By CHARLES R. KNIGHT.

119 pages, 9 x 12, illustrated with 44 full-page plates in monochrome from paintings by the author. 8/6

A beautifully produced book which vividly describes the world as it must have been millions of years ago.

The author's paintings of prehistoric life form part of the permanent collections of the American Museum of Natural History, the Field Museum in Chicago and the Los Angeles Museum, and there is perhaps no other artist who has laboured more zealously in the scientific spirit to make pictures of early animal life conform to exact evidence.

Of all Booksellers.

McGraw-Hill Publishing Company Ltd., Aldwych House, London, W.C.2.

BRITISH ASSOCIATION

for the ADVANCEMENT OF SCIENCE

Founded 1831; *Incorporated by Royal Charter,* 1928.

The Meeting in Norwich

Wednesday, September 4, *to Wednesday, September* 11, 1935.

President: Professor W. W. WATTS, F.R.S.

The British Association seeks to promote general interest in Science and its applications, and its Annual Meeting affords unique opportunity for conference and co-operation between scientific workers and others interested in all departments of Science.

The Association relies upon a full membership and attendance at its Meetings, to assure the support of the numerous scientific researches and other activities carried on under its auspices.

Particulars may be obtained on application to—

THE SECRETARY, BRITISH ASSOCIATION, BURLINGTON HOUSE, LONDON, W.1

Telephone: Regent 2109.

BRITISH ASSOCIATION

Reports of the Norwich Meeting

Members of the British Association will be interested to learn that the **EASTERN DAILY PRESS** will contain full daily reports and photographs.

The "Eastern Daily Press" (1½d.) is the only morning paper published in Norfolk.

The **EASTERN EVENING NEWS** (1d.), the only evening paper published in Norfolk, has the latest sporting and general news.

Arrangements can be made for members of the Association, attending the meeting, to have the "Eastern Daily Press" and "Eastern Evening News" delivered to their hotels or residences, and both papers will be posted to any address in the United Kingdom for the additional cost of postage, 1d. per copy.

Orders should be addressed to :—

THE PUBLISHER, "Eastern Daily Press,"
57, London Street, Norwich - Tel. 1450

THE **BRITISH ASSOCIATION**

HAVE WISELY CHOSEN
NORWICH AS THE
VENUE FOR THEIR
MEETINGS THIS YEAR.

FOR ALL HIS INSURANCES, THE WISE MAN WILL CHOOSE THE

NORWICH UNION
INSURANCE SOCIETIES

FOUNDED IN THE
CITY OF NORWICH OVER 130 YEARS AGO.

NOW HAS BRANCHES THROUGHOUT THE WORLD.

A SAFE SOUND INVESTMENT

ESTABLISHED 1852

NORWICH BUILDING SOCIETY

SHARES ISSUED AT
3½%
TAX FREE
EQUIVALENT TO
£4.10-4%

AN OLD SOCIETY WITH A VERY LARGE PROPORTION OF RESERVES

Assets now over	£1,000,000
Mortgage Advances exceed	£900,000
Reserves	£60,000

CALL or WRITE

HEAD OFFICE : { Sec., G. G. Crook, F.C.A., 34 (D.), Prince of Wales Road, Norwich.
London : 16 City Road, E.C.1.

THE INSTITUTE OF CHEMISTRY
OF GREAT BRITAIN AND IRELAND

The Institute of Chemistry was established in 1877 to provide the Government and the public with the means of recognising those who have been properly trained and proved to be competent to practise chemistry as a profession. In 1885 the Institute was granted a Royal Charter with definite authority to grant certificates of competency, and to register persons qualified to practise. The aims of the Institute include the elevation of the profession of chemistry and the maintenance of the efficiency, integrity and usefulness of persons practising the same, by compelling the observance of strict rules of membership, and by setting up a high standard of scientific and practical efficiency. Particulars of the Regulations and Examinations of the Institute can be obtained (*free*) on application to the Registrar.

ALL COMMUNICATIONS TO BE ADDRESSED TO THE REGISTRAR

INSTITUTE OF CHEMISTRY, 30, RUSSELL SQUARE, LONDON, W.C.1

DO YOU READ **ESTABLISHED 1903**

EDUCATION

THE OFFICIAL ORGAN OF THE ASSOCIATION OF EDUCATION COMMITTEES.

Published every Friday. *Price 2d. per copy.*
Annual Subscription—13/- post free

A weekly newspaper for Education Officers, Teachers and others interested in educational affairs. **School Building Supplement** included once a month.

Write for Free Specimen Copy to
THE PUBLISHERS,
COUNCILS AND EDUCATION PRESS, LTD.,
44, Russell Square, London, W.C.1.

HERIOT-WATT COLLEGE, EDINBURGH
(AFFILIATED WITH THE UNIVERSITY OF EDINBURGH).

FULL-TIME DAY COURSES for Diplomas and Certificates

MECHANICAL ENGINEERING	ELECTRICAL ENGINEERING
MINING ENGINEERING	OIL MINING
APPLIED CHEMISTRY	PHARMACY
BIO-CHEMISTRY	BREWING
BUILDING	PRINTING

ENTRANCE EXAMINATION : SEPTEMBER 17th and 18th
DAY COLLEGE ENTRANCE SCHOLARSHIPS

Three Scholarships, tenable for a Diploma or Degree Course, are offered to Students from Secondary and Higher Grade Schools, on the results of this examination. These Scholarships cover Matriculation Fees, Class Fees, Books and Instruments, with a Grant of Five Pounds.

SESSION BEGINS OCTOBER 15th

Full particulars from the College.

J. CAMERON SMAIL, *Principal*

Statistical Studies in Genetics and Human Inheritance

ANNALS OF EUGENICS

Edited by R. A. FISHER
Founded by K. PEARSON

Volume VI, Part II, contains articles by :

R. A. FISHER — **F. YATES**
M. N. KARN — **L. S. PENROSE**
R. R. KUCZYNSKI — **ELIOT SLATER**

Subscription in advance, 50s. per volume

Four quarterly parts, obtainable separately at 15s. each, from

THE GALTON LABORATORY
UNIVERSITY COLLEGE, GOWER STREET, LONDON, W.C.1

* *Applications for a specimen copy of the current part should be sent to the editor at the above address*

The Manchester Municipal COLLEGE of TECHNOLOGY

Principal : B. MOUAT JONES, D.S.O., M.A. (Oxford)

UNIVERSITY OF MANCHESTER
(Faculty of Technology)

DEGREE COURSES IN TECHNOLOGY

The Prospectus gives particulars of the courses leading to the Manchester University Degrees (B.Sc.Tech., M.Sc.Tech., and Ph.D.) and Certificates in the Faculty of Technology, in the following Departments :—

MECHANICAL ENGINEERING (Professor Dempster Smith, M.B.E., M.Sc.Tech., M.I.M.E.).

ELECTRICAL ENGINEERING (Professor John Hollingworth, M.A., D.Sc., A.C.G.I., M.I.E.E.).

MUNICIPAL ENGINEERING (R. J. Cornish, M.Sc.,A.M.Inst.C.E.).

APPLIED CHEMISTRY including General Chemical Technology, Metallurgy and Assaying, Fermentation Processes (including Brewing), Electro-Chemistry, Photography, Colouring Matters, Foodstuffs, Fuels and Chemical Engineering. (Professor James Kenner, D.Sc., Ph.D., F.R.S.).

TEXTILE CHEMISTRY (Bleaching, Dyeing, Printing and Finishing, Paper Manufacture) (F. Scholefield, M.Sc., F.I.C., F.T.I.).

TEXTILE TECHNOLOGY (Professor W. E. Morton, M.Sc.Tech., F.T.I.).

BUILDING (W. B. McKay, M.Sc.Tech., M.I.Struct.E., M.R.San.I.).

INDUSTRIAL ADMINISTRATION (Post-Graduate Certificate Course) (K. G. Fenelon, M.A., Ph.D.).

Prospectus will be forwarded free on application to the Registrar, College of Technology, Manchester, 1.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY,

LONDON,

Including as integral parts The Royal College of Science, The Royal School of Mines, The City and Guilds College.

The Imperial College is organised into departments as follows :—

Aeronautics (including Aerodynamics) ; **Biology** (including Botany, Plant Physiology, Plant Pathology, Biochemistry, Bacteriology, Zoology and Entomology), **Chemical Technology** (including Chemical Engineering, Fuel and Refractory Materials, Electro-Chemistry) ; **Chemistry** (including Organic Chemistry, Inorganic Chemistry, Physical Chemistry, Agricultural Chemistry, and the Chemistry of Food and Drugs) ; **Engineering, Mechanical and Motive Power** ; **Engineering, Civil and Surveying** (including Highway Engineering) ; **Engineering, Electrical** ; **Geology** (including Mining Geology and Oil Technology) ; **Mathematics and Mechanics** ; **Metallurgy** ; **Mining** (including Mining Surveying) ; **Physics** (including Astrophysics, Technical Optics, Instrument Design, Meteorology, and Applied Geophysics).

The Pregraduate courses extend over three or four years and lead up to an Associateship of one of the Colleges, and a B.Sc. Degree of the University of London.

The Postgraduate courses and Research lead up to the higher Diploma (D.I.C.) and to the Higher Degrees of the University of London.

The purposes of the Imperial College are to give the highest specialised instruction, and to provide the fullest equipment for the most advanced training and research in science, especially in its application to industry.

Prospectus (free) from the Registrar, Imperial College of Science and Technology, Prince Consort Road, London, S.W.7.

UNIVERSITY COLLEGE
SOUTHAMPTON.

A residential University Institution.

Inclusive fee for tuition and residence £95-110.

There are three Halls of Residence, organised on collegiate lines, accommodating 335 students.

The College is organised in Faculties of Arts, Pure Science, Engineering, Education, Economics and Commerce, and in Departments of Laws and Music. Special facilities for Research are provided in each Faculty.

The Degrees awarded to students of the College are those of the University of London.

A Calendar of the College may be obtained free on application to the Registrar.

The story of exploration

UNROLLING THE MAP

by **Leonard Outhwaite.** 56 Maps and some drawings. 16s. net

Near East : "The book contains 344 quarto pages of double columns and not one page that is not full of interest to any reader from schoolboy age onward."

J. M. SCOTT (*Sunday Times*) : ". . . . what the various explorers did and, as far as possible, why they did it . . . . It is a fine story."

Ideal for teacher and student

EVERYDAY BIOLOGY

by **F. L. Fitzpatrick and R. E. Horton** Illustrated 8/6 net

Schoolmaster : "This is a textbook from which a complete course in biology can be formulated for any type of school, and from which a student may obtain a thorough grasp of subject."

10 Orange St. **Constable** London, W.C.2

Slouch Hat

By MALCOLM BURR

Illustrated. 15*s.*

"Full of good stories, gay and grim . . . Dr. Burr has the faculty of interesting the reader in all his excursions into the by-paths of political and natural history and folk-lore which illustrate and diversify an excellent narrative."—*The Times.*

"Dr. Burr has written a book which will be of interest to all who have travelled in the Balkans and one which throws much light on a hitherto little-known and troubled region."—*Morning Post.*

"*Slouch Hat* should be read and studied by anyone who wants to know something of the Serbs *chez eux* and is not averse from being interested, amused and thrilled in the process."—*Near East and India.*

GEORGE ALLEN & UNWIN

IMPORTANT AND INTERESTING AUSTRALIAN PUBLICATIONS

BIRD WONDERS OF AUSTRALIA

by

A. H. Chisholm.

with 58 illustrations 6/- net.

INSECT WONDERS OF AUSTRALIA

by

Keith C. McKeown.

with 31 illustrations. 6/- net.

AN AVIARY ON THE PLAINS

By Henry G. Lamond.

Sketches of bird life in Queensland, full of interesting asides and odd bits of information, they are graphic, picturesque and full of the understanding and enthusiasm of a Nature lover. 6/- net.

BUFFALOES

By Carl Warburton.

Life and adventure in Arnhem Land. Illustrated. 6/- net.

WHALEMEN ADVENTURERS

By W. J. Dakin, F.Z.S.

The story of whaling from days of sail to modern times. Illustrated. 15/- net.

TOOTH AND TALON

By Henry G. Lamond.

Tales of the birds and animals of the Australian wilds. 6/- net.

Published at

37, Great Russell Street. LONDON, W.C.1

by

ANGUS & ROBERTSON, LTD.

LONDON — **WARNE** — NEW YORK

The Wayside and Woodland Series.

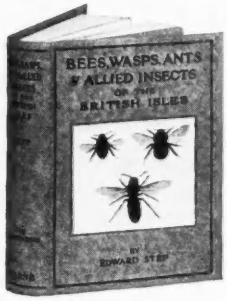
Issued this Spring:

THE SPIDERS AND ALLIED ORDERS OF THE BRITISH ISLES

By Theodore H. Savory, M.A.

Comprising full descriptions of every family of British Spiders, every species of Harvestman and False Scorpion ; also the more familiar of the British Mites. With 63 figures in colour by Florence M. Brummitt, 130 illustrations from photographs, and 61 Diagrams in the Text.

Price 10/6 net.



The Series Comprises :—

WAYSIDE AND WOODLAND BLOSSOMS. By Edward Step, F.L.S. (3 vols.) each **7/6** net.

WAYSIDE AND WOODLAND TREES. By Edward Step, F.L.S. Price **7/6** net.

WAYSIDE AND WOODLAND FERNS. By Edward Step, F.L.S. Price **7/6** net.

ANIMAL LIFE OF THE BRITISH ISLES. By Edward Step, F.L.S. Price **7/6** net.

LIFE OF THE WAYSIDE AND WOODLAND. By T. A. Coward, M.Sc., F.Z.S., F.E.S., M.B.O.U. Price **7/6** net.

THE WORLD IN THE PAST. By B. Webster Smith. Price **7/6** net.

THE BUTTERFLIES OF THE BRITISH ISLES. By Richard South, F.E.S. Price **7/6** net.

THE MOTHS OF THE BRITISH ISLES. By Richard South, F.E.S. (2 Vols.) Each **10/6** net.

BEES, WASPS, ANTS AND ALLIED INSECTS OF THE BRITISH ISLES. By Edward Step, F.L.S. Price **10/6** net.

THE BIRDS OF THE BRITISH ISLES AND THEIR EGGS. By T. A. Coward, M.Sc., F.Z.S., F.E.S., M.B.O.U. (3 Vols.). Each **10/6** net.

THE FISHES OF THE BRITISH ISLES. By J. Travis Jenkins, D.Sc., Ph.D., Price **12/6** net.

THE SEAS. By F. S. Russell, D.S.C., B.A., and C. M. Yonge, D.Sc., Ph.D. Price **12/6** net.

Every Volume Beautifully Illustrated in Colour.

A Handsome Illustrated Booklet of the Series is Available.

FREDERICK WARNE & CO., LTD.

Chandos House, Bedford Court, Strand, London, W.C.2.

DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. XVI. No. 189. SEPTEMBER, 1935 PRICE 1s. NET

Trustees: Sir J. J. Thomson, O.M., F.R.S., Sir F. G. Kenyon, K.C.B., F.B.A., Prof. A. C. Seward, Sc.D., F.R.S., Dr. Cyril Bailey, F.B.A.

Editor: L. Russell Muirhead, M.A.

Publishers: Benn Brothers, Ltd. All communications respecting editorial matters to be addressed to the Editor; all questions of advertisements and subscriptions to the Manager.

Offices: Bouverie House, Fleet Street, London, E.C.4. (Closed on Saturday.)

Telephone Central 3212. Telegrams: Benbrolish, Fleet, London.

Annual Subscriptions 12*s.* 6*d.* post free anywhere in the world. Single numbers 1*s.* net; single back numbers more than two years old, 1*s.* 6*d.* net; postage (inland and foreign) 2*d.*

Binding cases, price 2*s.* 6*d.* net each; postage 6*d.*

Notes of the Month.

For the second time in its history the British Association has settled on Norwich as the scene of its Annual Meeting. It is singularly appropriate that, in the person of Professor W. W. Watts, a geologist should have been selected to preside over this Meeting, as the actual soil of East Anglia provides splendid material for scientific investigation. Taking advantage of this, a four days' geological excursion immediately preceding the Meeting will examine the coastal and inland sections of Norfolk, and the special excursions arranged for the Geology Section are of exceptional interest and importance. Dr. Watts, in the message which he contributes to *Discovery* this month, lays stress upon the importance of East Anglia both in the social and scientific spheres.

* * * *

The last Norwich Meeting, in 1868, was presided over by a botanist, Sir Joseph Hooker—or, as he then was, Dr. Joseph Hooker. At that time the world of Science was still engaged in discussing, often somewhat acrimoniously, the Darwinian hypothesis of the origin of species. Hooker, though perfectly prepared as a scientist to engage in any amount of discussion, deplored the excess of feeling which was too often involved, and in his presidential address he made an appeal to the members assembled to approach the question in a spirit of judicial enquiry. Nowadays, happily, the proceedings of the Association are seldom clouded by any suggestion of bitterness, and Hooker would have been able to devote himself to questions more purely botanical. It is easy to imagine the interest with which he would have followed the work of the Fenland Research Committee, with its important investigations into the pollen deposits of the marshy soil of the fens; and he would no doubt have been surprised at seeing the once empty Breckland heaths covered with growing forest as they are to-day. For the fortunate members of the Association to-day expeditions have been planned for visits to fen and forest, and to much more of the varied scenery of East Anglia.

* * * *

The scientist, the historian, and the antiquary will find in the city of Norwich itself an ideal hunting-ground. Prehistoric man, the Gael and the ancient Briton dwelt on its site before the Romans built a road through it to serve their settlement at Caistor. The Saxons developed the town and founded a mint. The Normans built the Cathedral and Castle and Henry I bestowed the first Charter. The Tudor period was the golden age of Norwich: wealth poured in through the textile trade which, fostered by Flemish and French refugees reached its apex in the reign of Elizabeth. During this era Norwich, ranking as the second city in the Kingdom, built and restored churches, encouraged the arts, possessed silversmiths of national merit, and was a centre for the pomp and circumstance of successive Dukes of Norfolk and the powerful Howard family. In the early years of the 19th century the city adopted its present staple trade of ladies' and children's shoes. The fame of Norwich is also spread by its mustard and starch, electrical machinery and household appliances, aircraft, ironwork and other progressive industries.

* * * *

The largest city in a purely agricultural district which embraces three counties, and with its industries largely electrified, Norwich preserves the atmosphere of "the City of Gardens" which has been its title for centuries. Its streets are pages from the history of England, and ancient marches hand in hand with modern to the

detriment of neither. From its somewhat isolated geographical position, it has formulated its own culture and opinions. It possesses its own school of painting, and Crome, Stannard, and Cotman are names of artistic

The Maddermarket Theatre, Norwich, where Section H of the British Association will assemble this month.

merit. In literature it boasts Sir Thomas Browne, the Martineaus, Amelia Opie, and George Borrow, with Mr. R. H. Mottram as representative of the present generation.

* * * *

One of the main difficulties in assessing one's "racial" origins, mentioned in the article by Dr. Haddon and Dr. Huxley in this issue of *Discovery*, has been cleverly overcome by the German government, according to a recent report in *The Times*. Our authors ask their readers the pertinent question: How many of your ancestors can you actually name? Few of us can honestly go back more than three or four complete generations without expert assistance, and this assistance is now to be afforded in Germany by the Reich Office for Genealogical Research. Where documentary evidence cannot be found, the office will arrange for applicants to be examined by one of the anthropological institutes, which are authorised to certify Aryan characteristics. Attentive readers of the remarks of Dr. Haddon and Dr. Huxley on "Aryan Characteristics" will doubtless now look forward to the speedy publication of that long-awaited volume, Max Müller's "Dolichocephalic Dictionary."

* * * *

The Postmaster-General, in his recent announcement on the subject of Television, states that, on the recommendation of the Television Advisory Committee, he has authorised the British Broadcasting Corporation to make arrangements with the Baird Television Company, Limited, and the Marconi-E.M.I. Television Company, Limited, for the provision of complete transmitting equipment for the operation of their respective systems at the Alexandra Palace, and, subject to the settlement of certain outstanding points, orders will be placed accordingly. The work of manufacture and installation is expected to be finished in about six months. Test transmissions should start early next year, and should be followed shortly by a regular public service. Constructional work at the Alexandra Palace has already begun.

* * * *

On a later page of this issue we publish a survey of the immediate future of Television by a practising electrical engineer. The dispassionate tone of the article may help to discount some of the less guarded statements that have appeared elsewhere from time to time.

* * * *

What is, at the very least, a coincidence of some interest to archæologists has been revealed by two recent publications. We have received, reprinted from *The Journal of the Royal Society of Antiquaries of Ireland* (June, 1935), the report, by Mr. Seán P. O Ríordáin of some Bronze Age burials at Crookedwood, Co. Westmeath. In these, the characteristic sepulchral posture revealed the skeletons in "a closely flexed position, lying on the right side, the head towards the north, the right hand under the lower jaw and the left before the body." In the third of his articles on "Dead Libya," published in *The Times* on August 8th, Mr. W. B. Kennedy Shaw announced the discovery of a skeleton in just such a position (though he does not state the compass bearing of the head). This was in waterless desert some miles south-west of Selima Oasis, though traces of old mud-pans indicated that the spot might at one time have been suitable for habitation.

* * * *

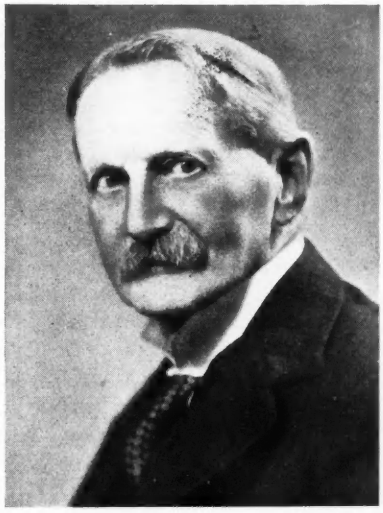
The new British Speleological Association, inaugurated on July 27th, with Sir Arthur Keith as President, proposes to serve as a centre for research and information regarding the caves of Britain. Latterly Britain has fallen behind France and Italy in the work of cave-exploration, despite much interest and activity in the north of England. The new Association will be in friendly rivalry with the Spéléo-Club de France, which has explored 600 caves since 1930, and the active local societies in Italy. Italian explorers hold the record for the depth they have reached, the deepest known Italian cave exceeding 600 metres. An account of French and Italian work in this field appeared in *La Nature* for August 1st.

The Norwich Meeting of the British Association.

By W. W. Watts, LL.D., Sc.D, F.R.S.
President of the British Association for the Advancement of Science, 1935.

DISCOVERY *once more has the honour of publishing, in its annual British Association Number, a message contributed by the President. Dr. Watts here remarks on the importance and appropriateness of Norwich as a centre for the Meeting and stresses the welcome tendency of the various Sections towards the interchange of ideas.*

THE meeting of the British Association at Norwich is the second to be held in that city, the first having taken place in 1868 under the Presidency of Sir Joseph Hooker. The forthcoming meeting will be one of unusual charm, the inhabitants having arranged a programme of events and entertainments well suited to the wishes and interests of a large variety of visitors. The country around the city too is delightful and well worth a visit and study on account of the varied nature of its natural history, its antiquities, and its examples of the application of science to industry and to the life of the community.



[*Claude Harris.*
Professor W. W. Watts.

The Association is now in the 105th year of its existence and this year's meeting is the 103rd, two having been missed in consequence of the war. Its chief object, as stated by one of its founders, was to give a stronger impulse and a more systematic direction to scientific enquiry, and all its minor purposes are included in this greater one. When it was founded there were not many scientific societies, and few of them, except the Royal Society, were more than small unions of specialists interested in one anothers' researches. As these have grown and multiplied till every science has its own meeting place and publications, and as international and other congresses are of frequent occurrence, it is sometimes supposed that the work of the Association is done. But, like other healthy organisations, it has grown and developed to meet the new needs as they arose.

First and foremost it is essential that those occupied in research should meet not only those working in their own science, but those engaged upon others, as so much new work is now opening out along borderlines. The division of the Association into many sections, and the care now taken with time-tables, enables members to visit sections other than their own when subjects likely it be of interest or use to them are being dealt with.

There are also the advantages of meeting with workers from overseas and abroad, resulting in the formation of fresh friendships often giving rise to a new standard or outlook. Such facilities occur not only in Section and Committee rooms and in formal debate, but at private and sectional gatherings, at social functions, and, perhaps most valuable of all, on excursions, which may be devoted to special scientific or industrial objects or may be of a more general character.

The tendency for two or more sections to join together in discussion has very much grown of recent years. Subjects are selected of wide bearing, where there is considerable difference of opinion, or where the contact of minds differing in outlook or method, or of diverse scientific training, may bring new knowledge, or new aspects of it, to the front. This year, for instance, there will be discussions or grouped papers on such subjects as atomic physics, the composition of coal, animal migration, lubrication, and the place of psychology in the training of teachers.

Another object, which is by no means "time-expired," is the formation of Committees to report on the state and progress of particular branches of science, or to carry out investigations. The reports drawn up collect and preserve data otherwise scattered, difficult to obtain, or liable to be lost, thus constituting a starting-point from which research can proceed. Other committees carry out definite research, either by their team-work, or by watching and aiding individuals who have shown promise or initiative. Others again, as well as individuals, have indicated the necessity for Government action either to make new departures or to renew or revive their activity.

The Association devotes all that can be spared from

its annual income from subscriptions and other sources, to objects of this kind, and it also administers certain trust funds that have been given by public-spirited and scientifically-minded donors. It is trustee also for the foundation established by Sir Buckston Browne for the maintenance of Charles Darwin's house at Down, and other institutions for scientific and medical research due to the same generous donor.

The Association naturally takes especial interest in the industries and occupations of the cities visited, in their municipal, educational, and social institutions, and in their antiquities and other objects of beauty or scientific importance. Not only are such treasures generously thrown open to observation and study, but usually guide-books are prepared for the benefit of visiting strangers, thus placing facts and figures on permanent record. A great file of guide-books has thus come into existence, marking the "trail" of the Association over the land and often providing a record of local changes and progress between successive visits.

Among the subjects of local interest to be dealt with on the present occasion are the drainage of the Fens, recent changes in arable farming, sugar beet, animal husbandry, soil formation and utilisation, the problem of the herring, and the early history of man in East Anglia.

As some return for the innumerable forms of hospitality so freely tendered to its members the Association is in the habit of providing lectures and demonstrations on subjects of local or leading scientific interest for members and, in some cases, for the general public; these are held not only in the cities of meeting but also in neighbouring towns. An attempt is also being made to deal with those branches of science which touch the life and social conditions of the community and to treat them as well as the more recondite subjects in language as little technical as possible. For instance, the chronology of the World Crisis will be dealt with, and also the application of science to the problems of road traffic and noise, and the results of State control of agriculture.

The Association has been successful in attracting young people to its meetings, and has fortunately been able, both out of its own resources and through the generosity of localities, to give help towards the necessary expenses. The contacts thus brought about, on committees, in section rooms, and on excursions, have been of great value both to the older and to the younger generations.

The Conference of Delegates held each year affords almost the only existing opportunity for representatives of provincial scientific societies to meet and discuss their difficulties, and to consult upon their plans of work. As a rule some one definite direction is taken up in connection with the conference each year, and the Chairman is chosen in relation to it. This year special attention is being given to the questions arising out of town planning in relation to places and objects of scientific interest or natural beauty. Here, and probably also in the sections the question of land utilisation in Breckland will almost certainly be taken up.

There is thus every prospect that the meeting will not only be a pleasurable experience, but also one of much scientific interest, both local and general.

General and Sectional Meetings.

The inaugural general meeting will take place at 8.30 p.m. on Wednesday evening, September 4th, when Professor W. W. Watts, the President, will deliver an address on "Form, Drift, and Rhythm of the Continents." So enthusiastic has been the attendance on past occasions at the inaugural meeting that it has been found necessary to issue special tickets of admission, only those members who have expressed a desire to attend the meeting being supplied with tickets. The evening discourses include Dr. S. J. Davies's lecture on "Diesel Engines in Relation to Coastwise Shipping"—a subject of vital interest to Norwich with its navigable river—and Dr. C. S. Myers's address on "The Help of Psychology in the Choice of a Career," in which we may hope to hear something of the invaluable work of the National Institute of Industrial Psychology. The Lord Mayor and Lady Mayoress of Norwich will hold a reception at the Castle Museum on September 5th, and H. M. Lieutenant for Norfolk and Mrs. Russell Colman will give a garden-party on September 10th.

The Charm of Norwich.

Norwich is especially fortunate in being able to provide the Association with so imposing a Reception Room as St. Andrew's Hall. This splendid mediæval building, dating from about 1460, was once the nave of a Dominican abbey-church, of which the monks were dispossessed by Henry VIII at the dissolution of the monasteries, and is now the scene of the Triennial Musical Festivals and other important gatherings. Its fine windows, with tracery in both the Late Decorated and the Perpendicular Gothic style, are worth more than a glance, and it is normally hung with portraits of eminent Norfolk men by distinguished artists. Most of the sections will meet in modern buildings, but the anthropologists are lucky in having allotted to them the charming old Maddermarket Theatre, an 18th century building reconstructed as an Elizabethan theatre, with apron stage, which has long been famous

for the productions of the Norwich Players under the able direction of Mr. Nugent Monck.

Some Special Occasions.

The Sections of the Association will begin their sessions on Thursday morning, September 5th, and will continue daily (except Saturday) during the meeting. The importance of East Anglia from the scientific point of view is emphasised by the number and variety of the papers that have already been promised on several aspects of local interest. An interesting anniversary commemorated by Section D (Zoology) is the landing of Darwin on the Galápagos Islands and the birth of the Darwinian hypothesis of the origin of species. Land utilisation plays a prominent part in the programme of the Geography, Botany, and Agriculture sections; scientific management, in the Economics section, and traffic problems, in the Engineering section, are other urgent problems under discussion. The Physiology and Psychology sections are joining forces to debate the problems of hearing and aids to hearing. Psychology again joins with Education in discussing the place of psychology in the training of teachers; and Physiology and Economics meet as one section to consider the economic aspects of diet. The Geology and Anthropology sections will find unlimited opportunities for their work in the country round Norwich.

Sectional Presidents.

The President of Section A (Mathematics and Physical Sciences) is Dr. F. W. ASTON, winner of the Nobel Prize for Chemistry in 1922, and a well-known authority on isotopes, the story of which he has chosen as a subject for his address. Professor W. N. HAWORTH, President of Section B (Chemistry), is Professor of Chemistry in the University of Birmingham, and will address the Section on "The Molecular Structure of Carbohydrates." In Section C (Geology) Professor G. HICKLING, Simpson Professor of Geology at Armstrong College, will speak on "Some Aspects of Coal Research" in his presidential address. Professor F. BALFOUR BROWNE will address Section D (Zoology) on "The Species Problem"; he is well known for his work as vice-president of the Royal Entomological Society and as president of the Royal Microscopical Society, and is now Professor of Entomology at the Imperial College, London. Section E (Geography) is presided over by Professor F. DEBENHAM, Professor of Geography at Cambridge; as he is head of the Scott Polar Research Institute, his address on "Some Aspects of the Polar Regions" should be specially interesting. Professor J. G. SMITH, President of Section F (Economic Science and Statistics), will speak on "Economic Nationalism and Foreign Trade"; he holds the Mitsui Chair of Finance at the University of Birmingham and is Dean of the Faculty of Commerce there; he has worked also at the Queen's University, Belfast, and on the Fiscal Enquiry Committee for Irish Free state. Mr. J. S. WILSON will speak on "Stability of Structures" in his presidential address to Section G (Engineering); he is a prominent civil engineer and has been principal assistant to Sir Benjamin Baker. In Section H, Sir ARTHUR SMITH WOODWARD, President of the Palæontological Society, takes the chair; the subject on which he will speak is "Recent Progress in the Study of Early Man." Sir Arthur is a past president of the Geological and the Linnean Societies, and served for many years as Keeper of the Geographical Department of the British Museum. Section I (Physiology) has as its President Professor P. T. HERRING, Chandos Professor of Physiology and Dean of the Faculty of Science at St. Andrews; the subject of his address is "The Pituitary Body and the Diencephalon." Dr. LL. WYNN JONES, President of Section J (Psychology), who has been Lecturer in Psychology at the University of Leeds since 1920, will address the section on "Personality and Age."

In Section K (Botany), the President is Mr. F. T. BROOKS, Reader in Mycology in the University of Cambridge, and one of the foremost authorities on flowerless plants; his address deals with "Some Aspects of Plant Pathology." "Education and Freedom" is the choice of Dr. A. W. PICKARD-CAMBRIDGE, President of Section L (Education), for his address. Dr. Cambridge is Vice-Chancellor of Sheffield University and is a profound classical scholar; his publication, "Education, Science, and the Humanities," shows a keen appreciation of the value of the various subjects in an educational curriculum. Dr. J. A. VENN, President of Queen's College and Lecturer in the History and Economics of Agriculture at Cambridge, will preside over Section M (Agriculture); he will speak on "The Financial and Economic Results of State Control in Agriculture."

The Delegates' Conference.

The Conference of Delegates of Corresponding Societies is this year in charge of Professor P. G. H. BOSWELL, Professor of Geology at the Imperial College, London. This branch of the Association's activities sounds dry enough to the uninformed; actually it is one of the most important and interesting of the year's functions, and offers almost the only opportunity for social and professional interchange of ideas between the societies supporting the Association. In Professor Boswell's able hands the results of the Conference should be especially fruitful.

Racial Myths and Ethnic Fallacies

By A. C. Haddon, F.R.S., and J. S. Huxley, D.Sc.

The myth of the "Aryan race," arising out of an unguarded remark of Max Müller's, is only one of many such fallacies which the nations have created, largely to satisfy their patriotic sentiment. Examined under the brilliant light of statistical science, these concepts dissolve like the wraiths they are. In the course of this article our authors bring to light many facts that will surprise the reader, and perhaps cause him to reflect on what his own ancestry may have been.*

DESPITE the new orientation given to the study of man by the Darwinian movement, the metaphysical and frequently mystical concept of race as a separately existing entity continued and still continues to dominate the treatment of human groupings. The racial concept is almost devoid of biological meaning as applied to human aggregates, but it is extremely difficult to remove it from popular use. The confusion has been worse confounded by certain developments of anthropological and of political theory. These have tended to widen the connotation of the term "race" and to admit implications of a psychological and cultural character, transcending any strictly biological concept, and sometimes all reason and evidence.

Passion and Prejudice.

Thus the adoption of the evolutionary standpoint in the study of language and culture has often led to rash and reckless use, in these spheres, of biological terms and of the ideas that are at the back of them. Biological principles have constantly been extended to the domain of language, of character, of morals, of culture, of art, of religion, without the necessary reservation that such principles cease to be axiomatic when applied elsewhere than in the biological field. Thus all too frequently ambiguities in the use of terms have been concealed, discussion based on emotion has assumed a pseudo-scientific guise, and the whole question of the inter-relation of human groups has been hidden in a fog of verbiage in which little but passions and prejudices can be clearly discerned.

It was only as the facts collected in the field and laboratory accumulated and were subjected to scientific analysis that the true nature of the problem emerged, and classification of peoples by language and culture ceased to be regarded by men of science as having any genetic significance, or as establishing a common ancestry.

Language is frequently passed from one group to another. Sometimes a conquering people forces its language on the conquered; sometimes it loses its own language and adopts that of the conquered group. Large numbers of people in South America with varying amounts of Indian genes in their genetic make-up speak only Spanish. Almost all Negroes in the United States speak English. The spread of Arabic by conquest is a notable historic phenomenon. The Norman invaders of England, in spite of Scandinavian ancestry, had adopted French as their language, and later took over much Anglo-Saxon from the people they conquered.

What is true of language is true also for other cultural elements. Habits, inventions, ideas spread by culture-contact: their distribution need show no relation with descent or physical relationship.

Terms like "Celtic," "Jewish," "Indian," "Arabic," or "Irish" may serve to denote a people or group of peoples bound together by tradition, or history, or language, or religion, or geographical contiguity, or united by cultural affinity or political usage (or misusage), even though the members of such a people are diverse in origin. As designations of ancestral types they erroneously apply a linguistic or a nationalistic terminology to a concept which should be defined only in terms of genetic transmission, or at least in terms of resemblance in physical characters.

Moreover it must never be forgotten that man, though an animal, is a unique animal. Biologically, his outstanding characteristic is his capacity for transmitting experience by what we may broadly call tradition, without recourse to physical inheritance. Thus it comes about that those characters of man which are biologically most important, such as speech, gesture, habit, cultural traditions, and all their associations and results, are precisely those which are found in no other animal species. They are of great interest and importance, but they are not and cannot be criteria of genetic composition or genetic origin.

The Aryan Myth.

There is one particular and very unfortunate ascription of the methods of one science to that of another, the repercussions of which have been so intense that we must discuss it separately. It is the myth of the existence of an "Aryan race." The reader should be acquainted with the history of this extraordinary misunderstanding.

Despite the fact that England has had commitments

* From *We Europeans*, by A. C. HADDON, F.R.S., and J. S. HUXLEY, D.Sc., to be published by Jonathan Cape in September at 7s. 6d.

in India from the time of Queen Elizabeth, there was no scientific interest in the languages of that sub-continent until the end of the 18th century. In the year 1783 the eminent oriental scholar, Sir William Jones (1746-1794) landed in India as Judge of the High Court of Calcutta. He entered at once upon the study of the Indian languages. During the remaining ten years of his life he demonstrated the relationship of the Sanskrit and allied tongues to the main vernaculars of Europe.

It was Sir William Jones who introduced the word *Arya* into modern European literature. He used it in a translation from Sanskrit in a perfectly correct and purely linguistic sense, to distinguish the speakers of certain Indian languages from others. Later it has been used to denote the speakers of the Aryan or Indo-European family of languages ; or sometimes to denote the languages themselves. The word itself means " noble " and is applied especially to deities. It is of Sanskrit origin, occurs also in Zend, and passed thence into Persian and modern Indian dialects. It was used by the Greeks and Latins as a description of Eastern Persia, the district now called Afghanistan (Latin *Ariana*, modern *Iran*). *Arya* has been used also, as Sir William Jones well knew, as a religious group-name, to distinguish the worshippers of the gods of the Brahmans from the worshippers of certain other Indian deities.

Honest Philology.

During the first half of the 19th century the work begun by Sir William Jones was carried on by European philologists, especially in Germany. It came to be realised that there was a concrete group of languages which had certain very distinctive common factors and included Sanskrit, Zend, Sinhalese, Pehlevi, Pali, Armenian, Persian, Greek, Latin, as well as the Celtic, Teutonic, Slavonic and other sub-groups. Hittite has recently been shown to be of the group. The greater number of these languages are or were spoken in Asia. They came to be described as " Aryan," though they were also called " Indo-European," " Indo-Germanic " and sometimes—following a Biblical theory—" Japhetic." There was, however, always a tendency among philologists to restrict the use of the word Aryan to the Asiatic portion of this group of languages. This restriction rested on the firm ground that only the ancient Indian and Persian speakers of this family of languages called themselves *Arya*.

It fell out that at the beginning of the 19th century the Romantic school in Germany became attracted to the study of the Indian languages. This was largely the result of the efforts of the romantic poet, Friedrich von Schlegel (1772-1829), who, with his equally romantic wife—herself a daughter of the Jewish philosopher Moses Mendelssohn (1729-1786)—, became deeply impressed by Sir William Jones's translations from the Sanskrit. Friedrich von Schlegel learnt the language and induced his brother, August Wilhelm von Schlegel (1767-1844) to do likewise. In 1818 August Wilhelm became, at the University of Bonn, the first Professor of Sanskrit in the West.

From Schlegel's time to the present, the study of the philology of the Indian languages and their relation to the European has been pursued in Germany with more zeal than in any other country. We are not concerned with the general course of these investigations, but there is one incident which is specially important for our theme.

The Apple of Discord.

In the early years of the reign of Queen Victoria—from 1841 to 1854—the Prussian Minister to Britain was Baron Bunsen (1791-1860), whose grandson was British Ambassador to Vienna at the outbreak of the Great War. Baron Bunsen was a considerable scholar and his head was full of German philological enthusiasm. In 1847 he read a paper to the British Association at Oxford, in which he sought to show that the whole of mankind could be classified according to language and that comparative philology was a valuable anthropological guide.

About this time there came to England, under Bunsen's patronage, the young German scholar Friedrich Max Müller (1823-1900) who settled in Oxford in 1848 and remained there for the rest of his life. The high character and great literary and philological gifts of Max Müller are well known. About 1853 he introduced into current usage the unlucky term *Aryan*, as applied to a large group of languages. His use of this Sanskrit word contains in itself two assumptions—one linguistic, that the Indo-Persian sub-group of language is older or more primitive than its relatives ; the other geographical, that the cradle of the common ancestor of these languages was in the Ariana of the ancients, in Central Asia. Of these the first is now certainly known to be erroneous and the second is at least very doubtful. Around each of them a whole library of literature has arisen.

Moreover, Max Müller threw another apple of discord. He introduced a proposition which is demonstrably false. He not only spoke of an Aryan language and its descendants, but also of a corresponding " Aryan race." The idea was rapidly taken up both in Germany and in England. It affected to some extent a certain number of the nationalist historical and romantic writers, none of whom had any ethnological training. It was given especial currency by the French author Count Joseph de

Gobineau (1816-82). Of the English group it will be enough to recall the names of Thomas Carlyle, J. A. Froude, Charles Kingsley, and J. R. Green.

In England and America the phrase "Aryan race" has ceased to be used by writers with scientific knowledge, though it appears in political and propagandist literature. In Germany the idea of an Aryan race received hardly more scientific support than in England. Nevertheless, it has found able literary advocates, has been made to appear very flattering to local vanity, and has steadily spread, fostered by special conditions with which we are not concerned, though some of its fruits are very evident.

Max Müller was later convinced by scientific friends of the enormity of his error and he did his very best to make amends. Thus in 1888 he wrote "Aryans are those who speak Aryan languages, whatever their colour, whatever their blood. . . . To me an ethnologist who speaks of Aryan race, Aryan blood, Aryan eyes and hair, is as great a sinner as a linguist who speaks of a dolichocephalic dictionary or a brachycephalic grammar." Max Müller frequently repeated his protest, but, alas! in vain. "The evil that men do lives after them, the good is oft interred with their bones"! Who does not wish to have had noble ancestors? The belief in an "Aryan race" had become accepted by philologists, who knew nothing of ethnology—and even by a few ethnologists who had had no technical training and no clear idea of the biological meaning to be attached to the word "race." The influence of the idea of an "Aryan race" vitiates the work of a small band of anthropologists to this very day. If the term Aryan is given a racial meaning at all, it should be applied to that ethnic unit, whatever it was, that first spoke a language distinguishable as Aryan. Of the character of that hypothetical unit it is the simple truth to say that we know nothing whatever. The balance of evidence appears to suggest that it may have dwelt in the region of the Caucasus. Some think it dwelt South and East of that area, others that it dwelt West and North.

What is the "Aryan" Complexion?

We shall not follow the history of the Aryan controversy: It will be enough to say that while the Germans claimed that the Aryans were tall, fair, and long-headed—the hypothetical ancestors of hypothetical proto-Teutons—the French, mainly on cultural grounds, claimed that the language and the civilisation came into Europe with the Alpine Eurasiatics, who are of medium build, rather dark, and broad-headed. The decipherment of the language of the very Jewish-looking Hittites—which was certainly Aryan—and the discovery of certain Aryan languages in North-West India may give a new complexion to the whole question.

Both the German and the French views cannot be entirely true, but both may be partially or entirely erroneous. In so far as the *origins* of our civilisation can be associated with any particular physical type, it must be linked neither with the Nordic nor with the Eurasiatic but rather with the Mediterranean. And when we come to deal with the existing ethnic conditions of Central Europe the prevailing physical type is Eurasiatic rather than either Nordic or Mediterranean.

Who were Your Ancestors?

We pass from discussing errors concerning the origin of the population of Europe to consider elements that are not only obscure or misconceived, or both, but are also unbelievable. In all discussion concerning ethnic groups it has always been difficult to reach firm ground in anything like an accurate and extensive record of the actual descent of the individuals to be investigated. The uncertainty of their own descent seems to be unrealised by the great majority even of educated people. One frequently hears and reads the statement, for instance, that an individual is a "member of a family which has resided at such-and-such a locality for hundreds of years." It is not realised what vast research the tracing of such a descent would mean.

Suppose we wish to trace a family history back to about the year 1700—say 240 years—a claim by no means unusually made. Allowing thirty years for a generation this would mean eight generations and (without allowing for kin-marriages) 510 individuals, that is to say, two parents, four grandparents, eight great-grandparents, and so on. How many people know anything about their 510 ancestors to the year 1700? We shall be surprised if many of our readers can give even one-tenth of that number of their names. What proportion of people can give even the names of all their eight great-grandparents, let alone give any account of all of them? Enquiry among friends will elicit the fact that the proportion is negligibly small. The descent can usually be traced in the male lines for several generations but the record through the female lines usually soon fades out.

Some Illegitimacy Figures.

Moreover, to trace legitimate descent back through eight generations would involve the investigation of 255 separate fertile couplings, all of which must be in wedlock. On this matter the question of illegitimacy comes in. We have examined the comparative figures of illegitimacy and have arrived at the conclusion that no ethnologist who is investigating Europe can afford to

ignore this very important factor. The figures are approximately as follows :—

Country.	*Illegitimate births. Per cent. of total births.*	
Austria	27.0	increasing
Belgium	4.3	decreasing
Bulgaria	1.5	stationary
Czechoslovakia	1.1	,,
Denmark	10.1	,,
England and Wales	4.5	decreasing
France	8.5	,,
Germany	12.1	increasing
Holland	1.8	decreasing
Hungary	8.8	stationary
Italy	1.31	,,
Scotland	7.2	,,
Switzerland	4.4	,,

These figures represent the statistics of illegitimacy in official returns. Such figures cannot, however, of their nature include certain other categories. Firstly, there are the children of married women by other men than their husbands. Secondly, there are the children of single women falsely returned as married. There can be no means of estimating these categories ; but the true figures of illegitimacy must be considerably higher than the returned figures. Illegitimacy has thus to be taken into account in considering all descents.

From our table it will be seen that the highest figures are in the German-speaking countries. For the very high figures in Austria there are special reasons of a social and religious nature which we need not discuss here. In Germany nearly one person in eight is born officially illegitimate and a yet higher proportion must be actually illegitimate. Under such circumstances what chance will there be of any reliable knowledge of a descent involving 255 couplings in the last two and a half centuries ? On this as on many other grounds we must dismiss all idea of " purity of racial descent " among human beings as a figment without any adequate basis of support derived from observed fact.

The Melting-Pot.

The most extensive investigation that has yet been made of supposedly " pure stocks " is that of Dr. Ales Hrdlička in *The Old Americans* (1925). It is an excessively laborious and painstaking piece of work. Its author set out to investigate the physical characters of Americans of long American lineage. He soon found that in effect he could not go beyond grandparents, and even then true " Old Americans," who satisfied his scientific standards as to the American birth of their grandparents, were far from easy to find. He was able, however, to investigate some two thousand of them. These, to judge by their measurements, were a highly variable group and more dark than fair. In the following table we give only the figures derived from the pigmentation of the males.

Skin colour	Light	0.5	per cent.
	Medium	67.5	,,
	Swarthy	27.5	,,
	Freckly	4.5	,,
Hair colour	Light	5.3	,,
	Light brown	16.0	,,
	Medium	50.0	,,
	Dark	25.0	,,
	Black	1.1	,,
	Red	2.6	,,
Eye colour	Light	31.0	,,
	Mixed	52.5	,,
	Dark	16.5	,,

The other figures and measurements of the " Old Americans " varied about similar ranges. Of the figures as a whole it may be said that they represent a fair random sample of Europeans taken with an avoidance of those from the Mediterranean region (which is not the same thing as an avoidance of the Mediterranean type). The study of Dr. Hrdlička's work will leave little doubt that the well-known " American type " is a product of social, not of genetic factors, and that the Nordic element in the " Old Americans " is small.

The Extinct " Uncle Sam "

This is strengthened by the marked change in physical appearance to be noted in the United States during the last fifty or sixty years. What used to strike foreign observers was the prevalence of tall lantern-jawed individuals : what strikes them now is the prevalence of square-faced stocky business men. Uncle Sam has given place to Mr. Babbitt. In so far as this represents a real change—and there is good reason to suppose that it does so to a measurable extent—it must be largely due to social modification.

Hitherto we have considered the difficulties and pitfalls of the ethnologist when he is treating separate ethnic groups. When he turns to what is, after all, his main task, the presentation of some picture of man as a whole, that is the inter-relation of ethnic groups, then difficulties accumulate beyond present solution. In theory, taking the whole world as his province, it might perhaps be expected that he could plot out his grouped characters in such a way that the whole of mankind should fall into natural classes of which the affinities could then be demonstrated according to a scale of related characters. In actual practice it soon becomes evident that no two of the grouped characters which have been made the basis of classification coincide in distribution. Wavy hair does *not* invariably accompany a narrow prominent nose, and the associated stature may be tall or short. A fair-haired people is *not* invariably dolichocephalic or blue-eyed. When the distribu-

tion of character is plotted geographically, the resulting map is like a sheet of paper on which half a dozen or more different colours have been spilt one on top of each other, and allowed to run irregularly at the edges. The reason for this is the relative independence of characters after crossing, due to the existence of separate Mendelian genes and their capacity for recombination.

It follows that any attempt at racial classification which is based upon the distribution of characters must be content with an arrangement which holds good only in general terms and is subject to numerous cross-divisions. It must aim at constructing a map rather than a set of neat pigeon-holes.

On the other hand the ethnologist may, and very frequently does, approach his problem by reference to previously defined hypothetical types, although this may not always be admitted by him. This method is perfectly legitimate in certain stages of an inductive science, but in ethnology it has stimulated generalisation from inadequate data. Recent advances in our knowledge of genetics throw doubt upon its value for our particular theme. For this the manner of growth of ethnological investigation is partly responsible. Geographical exploration has proceeded piecemeal and knowledge of the different varieties of man has been gathered here and there and little by little. Thus types found in remoter parts of the world have been described before material has been available for the systematic study of the problem as a whole.

In all this, of course, ethnology does not differ from any other branch of systematic study of material from a wide geographical distribution, but in the study of the races of man the result seems to have been peculiarly unfortunate.

A Futile Error.

A great part of ethnographical literature is vitiated by what seems a peculiarly elementary error. Descriptions of population are given a false appearance of exactness by the use of average figures for measurements, sometimes with the addition of extreme variations. Such statements have no greater value than general impressions. If we are told that in a group of, say, twenty individuals " the average height is five feet six inches " we know nothing of the composition of the group. It may, for instance, consist of ten giants of six feet six inches, and ten dwarfs of four feet six inches. If to the statement is added the additional qualifications that the extremes are five feet and six feet, we still know nothing of the group except that it contains no dwarfs and no giants. It may consist of ten tall individuals of six feet and ten short individuals of five feet, or it may contain one individual of five feet, one of six feet, and eighteen of five feet six inches. And there is an infinity of variants between these extremes.

Nevertheless anthropological literature is full of meaningless statements such as this. They fill the pages of most of the many books on " The Races of Man." This false method has been misapplied with endless industry, especially to head-measurements. Such measurements are most easily made on specific social and political groups, and on their fallacious results all manner of hypotheses have been and are being erected around the mystical conception of race. The only expression of measurements that is worthy of scientific treatment must be in the form of curves expressing the degree of deviation from the mean. For even these to have any value it is necessary for the investigator to know exactly the nature of the group that is being measured ; whether, for instance, it is a true random sample or whether there has been some selection, and if so what is the nature of the selection.

Misleading Similes.

There is another group of ideas concerned that has not only introduced an extraordinary number of errors and misunderstandings into discussions as to the "races" of man, but has also involved a fallacious method of presentation. The evolution of man and, specifically, of the existing varieties of man, is frequently represented in the form of a tree. Much misunderstanding has unfortunately arisen in the course of evolutionary discussion, by the use of this term and its dependents, " stem," " stock," " branch " " twig," etc. The simile is in many ways very unfortunate, since the essential picture created by a tree is that of roots converging in a trunk which ascends, becoming smaller, and gives off branches on the way. Now most of the elements of this picture must be discarded if we would visualise the process of biological descent. First, there are no converging roots. Secondly, all trees have an innate rule of growth determining their general habit, whereas in biological descent the place and time of branching is determined by opportunity and by external circumstances as well as and as much as by internal powers. Thirdly, the question of which is branch and which trunk has an obvious answer for a tree, but is by no means obvious at any particular level of evolutionary descent. Fourthly, evolutionary branches may—if they have not proceeded too far—unite again after they have diverged and then either rebranch or remain united.

The great flow of life is, in fact, something unique in Nature which is insusceptible of presentation in similes. Instead of a tree we may compare the course of life rather to a conduit or stream. The flow goes on. From time to time it gives off a secondary stream which,

if it does not travel too far, may rejoin the main flow. If it pass beyond a certain narrow limit it can never rejoin that flow from which it came. But our stream or conduit never receives true tributaries. Moreover, while it gives off secondary streams which may not rejoin the main stream since they become "specialised," it never thereby loses substance, for it becomes replenished from its own internal reproductive powers. Here, too, the simile breaks down, and life can be understood only by direct and prolonged study of those phenomena which it alone presents.

One of the most pernicious of all methods of viewing the European scene is what we may call the "systematised anecdotal." Each nation and each group within each nation forms its own idea of itself. There can be little doubt that in our days the scientific, like the political and social conscience of mankind, has been stirred to its depths by an entire misapprehension of one nation of its place among the nations.

> O wad some power the giftie gie us
> To see oursel's as ithers see us!
> It wad frae mony a blunder free us
> An' foolish notion.

There is such a power and that power is science and especially the science of statistics. It would doubtless surprise many Germans to learn that in Germany the returned rate of illegitimate to total births is the highest in Europe except that of Austria, and that it is nearly three times as high as in England and 50 per cent. higher than in France; that in Germany the suicide rate is double that in England and half as high again as in France, and that in Germany the murder rate is four times that of England and twice that of France. In all these ways Germany and the German-speaking countries occupy an unfortunate pre-eminence in Europe. Doubtless, by taking statistics on certain other matters we should discover that our own country was in no position to cast stones at others. That is a good reason to avoid national complacency on the one hand, and on the other to seek that humane and objective attitude which science—the instrument of reason and the stiller of prejudice—alone can give.

It is difficult to avoid the conclusion that not a few of the anomalies which are encountered by those who have endeavoured to trace the "racial affinities" of the varieties of man have arisen from an *a priori* approach to the problem. Characters have been attributed to a preconceived type, rather than the actual type determined by its characters. Tables of racial affinities have been drawn up for which there is very little ponderable evidence. Conflicting facts have been ignored. Such, for example, is the fact that types have been postulated as a logical necessity without due emphasis on their hypothetical character, although no individual in a given population may conform in all characters to that type.

This concept of an original ideal type, later obscured by the admixture of alien elements, has provided the intellectual foundation for the whole argument of the "Nordic theory" and the attitude that it involves towards "racial" and political problems.

[How far the "Aryan heresy" has been allowed to spread may be gauged by a recent article in *The Times*, in which a correspondent speaks of the Red Kafirs of Chitral as "authoritatively said to be a genuine Aryan people." As it is the contact of a German expedition with these and other little-known tribes of Chitral and the Hindu Kush that gives rise to the article, it is perhaps not very difficult to guess the origin of the "authority" that speaks of this tribe as "Aryan." If that vexed word must be somehow employed in describing racial characteristics, we would suggest the safe compound, "Aryan-speaking."—ED.]

Correspondence.

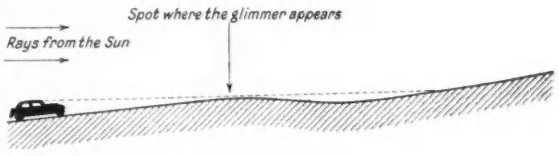
A MOTORING PHENOMENON.

To the Editor of DISCOVERY.

Sir,—Could any of your readers explain the following phenomenon?

Recently while driving about in my car I have witnessed thin bands of light, which give the impression of shallow expanses of water, lying on the tops of rises of roads.

I have only been able to observe this phenomenon on warm, sunny days, with the sun behind me; and only when the road rose higher in the distance than the rise where it was noticed.



Perhaps the appended diagram will help.

Yours faithfully,

C. L. WATSON.

Barnard Castle.

Dr. Zeuner calls our attention to an error in his article, "The Origin of the English Channel," in our July number. In the legend beneath the diagram on p. 197 the words, "in the Sub-atlantic period," should be omitted.

Scientific Problems in the Fine Arts.

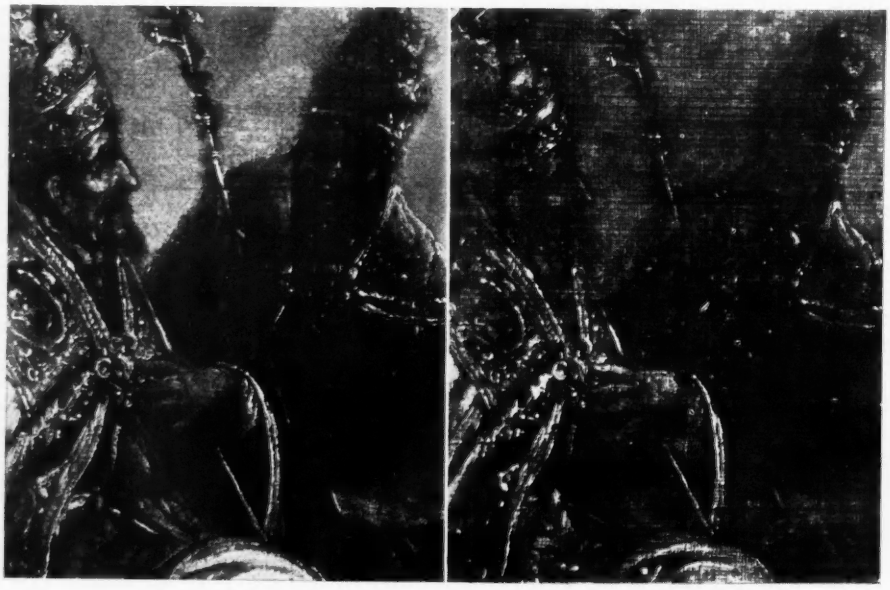
By P. D. Ritchie, B.Sc., Ph.D.
Courtauld Institute of Art, University of London.

A good deal of sensational publicity has been given to the detection of forged paintings by scientific means. Actually, as Dr. Ritchie explains, the scientific investigation of paintings is still in its infancy. Much good work has been done, however, with both X-rays and microchemistry and there is wide scope for further discovery and research.

THE systematic and critical examination of a work of art of any kind, by means of modern scientific weapons, can, if suitably directed, yield information of the highest significance on many debatable points—the genuineness or otherwise of the object, forgotten secrets of mediaeval technique and craftsmanship, the best methods of restoring damaged portions and preserving from further harm. But it is essential for success that the scientist and the art expert should work in close conjunction: for the history of style and the history of craftsmanship are quite inseparable, and even the most firmly-based scientific observation may of itself lead to a totally wrong conclusion, or be quite meaningless unless a mind skilled in the history of technique assists in its interpretation. A trivial but typical example will illustrate the point. The minute hole usually found in the face of the Madonna in early Italian tempera paintings might puzzle the microscopist, and eventually be set down as a casual, rather than a systematic phenomenon: but the craftsman would at once realise that it was caused by the compass-pivot in outlining the nimbus on the surrounding background of burnished gold-leaf.

The recent establishment by the University of London of a Scientific Department at the Courtauld Institute of Art has once more aroused a great deal of interest in this field: and, as usual, popular publicity has given rise to some misconceptions. It seems desirable to review briefly a few of the main weapons of attack, with the double view of emphasising their present limitations and pointing out some of the difficulties confronting the investigator.

The outstanding difficulty, of course, lies in the intensely individual nature of any given work of art which renders it virtually impossible to provide a satisfactory "control" for any experiment thereon. In the field of pure chemistry, it can fairly be assumed that any two samples of, say, methane would provide identical starting points for an experiment and its control—though the implications of the recent discovery of deuterium have somewhat undermined such an assumption. But in the case of, say, an oil painting, the object of experiment is a highly complicated system, in a state of physico-chemical equilibrium controlled by independent variables whose number and nature is quite unknown—a system so complex as to baffle the most ardent exponent of the phase rule. The materials



On the left is shown a photograph, on the right a radiograph of the same portion of a 17th century Spanish painting. Little fresh detail is revealed in this typical case by the X-rays, except the mesh of the canvas.

A more striking instance of X-ray investigation: on examining the portion of the first picture within the dotted line, the old man's head was clearly revealed. This is not necessarily a proof that the top picture is not genuine, but certainly furnishes a case for further enquiry.

employed, the tricks of craftsmanship involved in any work of art, and the interdependent mechanical stresses and strains, are often so little known and understood that the manufacture of a satisfactory standard duplicate for control experiments is almost impossible. Indeed, the scientific detection of forgeries depends upon this very fact—that such a forged duplicate, if sufficiently rigorously examined, will sooner or later be found to differ in at least one particular from its original, and is therefore an unsatisfactory control.

It is this absence of a norm for comparison which sets a very definite limit to the present usefulness of many modern scientific weapons in the fine arts field. The X-ray examination of paintings, for example, has occasionally led to results of such importance that a good deal of publicity has been given to this method of investigation: and it is apt to be forgotten that, at the present state of our knowledge, only a very small minority of pictures show, on X-ray examination, features whose significance can be interpreted with certainty. There is a tendency to read into the observed facts implications which are not scientifically justified. Many who should know better seem to regard a radiograph of a picture as at once a birth certificate, passport, and guarantee of its general respectability, whereas in nine cases out of ten such a radiograph merely repeats faithfully the already visible superficial features of the painting, with minor variations whose ultimate significance can at present only be guessed.

The illustration on p. 258, for example, is a photograph of a portion of a 17th century Spanish oil painting, on canvas; next to it is a radiograph of the same area, taken with very soft X-rays, in which the high-lights of the painting, laid in principally with white-lead, are exactly reproduced. The only obviously new feature consists of a "shadowgraph" of the texture of the canvas, due to the pockets of opaque white-lead priming which fill the grain of the fabric. This is absolutely typical of the results normally obtained, and it is only very occasionally that sensational discoveries are made thus. Sometimes, however, the radiograph reveals details of design which have subsequently been hidden by opaque overlayers of paint, possibly added by restorers, which may again be brought to light by cautious removal of the overpainting; and sometimes an artist in urgent need of a canvas may take an old picture and paint an entirely new subject on top of it, both subjects being revealed by X-ray examination should the pigments be favourable. The illustration above shows an 18th century canvas, in the Romney manner, which was recently submitted to X-ray examination, and the radiograph of the portion enclosed by the dotted line revealed, most surprisingly, a clear picture of the head of an old man—obviously the original "occupier" of the canvas. A favourite trick of the picture faker is to take a genuinely old but worthless picture, and build up around the existing design a picture in the manner of some well-known master; and this lends itself rather well to detection by X-ray photography.

Such cases are rare, however. Their interest is usually popular rather than scientific, and, since they depend essentially upon the presence in their structure of materials which are relatively opaque to X-rays, such as white-lead or vermilion, their detection is fortuitous, and cannot be foreseen. But occasional deductions of great interest can be made from an apparently featureless radiograph. In a recent case, for example, a 16th century Italian portrait was examined, which was stated to have been painted originally on a wooden panel, and subsequently transferred by some picture restorer

to a canvas foundation. A radiograph was taken, on which was visible a well-marked canvas texture, due as usual to the dense priming coat. On counting the number of warp and weft threads to the inch, it was found that this texture did not correspond to that of the canvas actually visible at the back of the picture. Further, since the picture was forty by thirty inches in size, it was almost certain that had it been painted on panel, instead of on canvas, the panel would have been built up in several sections; yet no trace of the expected functions between such sections was found in the radiograph. Without claiming a rigid proof, it was a fair deduction that the picture had not been painted on panel, and that two canvases were involved in its structure—one heavily primed, which showed up in the radiograph and was probably the original foundation of the picture, and one, visible from behind but invisible in the radiograph, which was a modern relining canvas reinforcing the fragile old foundation and attached thereto by some adhesive, such as beeswax or Venice turpentine, which offered no great obstacle to the passage of the X-rays.

The Fluorescence Test.

It is seldom that such a positive deduction can be made, and the same applies to the examination of a picture by ultra-violet or infra-red radiation—two methods of investigation whose undoubted value is limited as before by the impossibility of satisfactory control experiments. When a work of art has been repaired, it very often happens that when it is irradiated with ultra-violet light the modern additions exhibit a visible fluorescence different from that excited in the original portions. The fluorescence of some types of marble, for example, shows a very striking progressive change from intense violet to a mottled yellowish-white as the surface of the stone "ages" by atmospheric weathering, and modern repairs to ancient marble sculpture can thus be readily detected. But, once again, the subject is full of pitfalls, and in the case of a heavily restored painting the characteristic tell-tale fluorescence of the restorations may be entirely masked by that of the homogeneous superficial layer of varnish, which may have to be removed by solvents before the examination can be completed satisfactorily. The method is undoubtedly of very great potential value, however, and a prolonged accumulation of results, checked as well as possible by carefully devised control experiments, may lead to the development of the present rather empirical technique into an exact science. Much valuable work has already been done in this direction.

Recent advances in the technique of micro-chemical analysis have rendered it a comparatively easy matter to identify the pigments employed in a picture or manuscript; and this is of the utmost value when used in conjunction with the tentative tables showing the chronological occurrence of most of the classical pigments, which have been compiled by Professor A. P. Laurie, Dr. de Wild, and other pioneer workers. The presence of the relatively modern cobalt blues, for example, can be readily detected in extraordinarily minute samples by the formation and microscopic observation of the characteristic brilliant blue anisotropic needles of the double thiocyanate of cobalt and mercury. Spectrographic methods are also extremely sensitive and valuable in this connection.

Identification of Pigments.

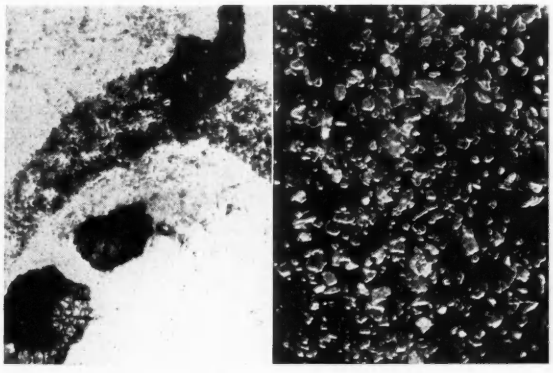
It occasionally happens that the mere characteristic appearance of a pigment under the microscope provides an indication of its identity. The illustrations opposite show: above, a portion of a 12th century German or Austrian manuscript, and below, a photomicrograph of a portion of the illuminated capital letter, in which the appearance of the individual granules of azurite was sufficient to identify the blue pigment; while alongside the latter is shown the typical appearance of azurite itself under high magnification. Liberation of carbon dioxide on treatment with acid, and the appearance in the arc-spectrum of the "raies ultimes" of copper at $\lambda 3274$ and $\lambda 3248$ completed the identification of the pigment.

Identification of the medium, however, is considerably more difficult, and usually much more important, than that of the pigment. Obviously, only microscopic samples can be removed for analysis from a valuable painting, and the positive identification of minute traces of "dried" linseed and poppy oil, size, fish glue and animal glue, casein, white of egg and yolk of egg, beeswax, resin, and shellac, and gums so similar as mastic, damar, and gum arabic, is a matter of extreme difficulty, especially as mixtures of such materials were sometimes used when one painting technique was giving way to a new experimental technique. Colour tests are here almost useless owing to the infinitesimal quantities available, and this particular field of investigation offers a striking challenge to the scientist.

The usefulness of the spectrograph has been mentioned. This lies not merely in its sensitiveness, but also in the permanent and objective nature of the record provided. Any scientific weapon which helps to eliminate the personal and subjective factor from evidence collected in this highly personal field must be hailed with enthusiasm. The thorny problem of attribution to a definite master, for example, is a question on which the evidence must of necessity be almost entirely subjective. Flair,

seventh sense, and wide personal experience are the weapons of the connoisseur in deciding whether a picture is by, say, Rembrandt, or his pupil, Bol. A picture may be radiographed, its pigments analysed, its medium detected, its brushwork photographed, but there is no mathematical function of the results obtained which can be applied to identify the hand of the master. The print of a finger can be definitely characterised by the dactylographer, but there is no accurately measurable quality or quantity whereby the print of genius can be assessed. Subjective evidence—matters of opinion alone—are outside the province of a scientific laboratory.

It is only rarely that a clear-cut scientific proof can be obtained of the genuineness of a work of art, and even then it is usually as a result of detective work arising from a chance observation, rather than as a consequence of some routine test. A case in point was a highly suspect tempera panel of the Madonna and Child, richly gilded and brightly coloured, purporting to be early 15th century Italian. Stylistically, the panel was completely wrong ; that much the art experts conceded. What was wanted, however, was a definite scientific proof of its " wrongness," and that proof was very hard



Left : Photomicrograph (×18) *of the capital E shown on the MS. above, revealing azurite granules. Right : Granular azurite under high magnification* (×50).

to obtain. Microchemical examination of the pigments revealed nothing incompatible with a 15th century Italian palette—vermilion, gold-leaf, malachite, terre verte—and the technique, as far as could be seen, was quite in keeping with the supposed period. A few details were suspicious, but not convincing—the modern appearance of the saw-cuts whereby the pointed top of the ancona had been shaped : the inferior quality of the pastiglia work, and the gold-stamping of the nimbus around each head ; flaws in the brushwork of the eyelids, obvious in enlarged photographs, which were incompatible with the customary skill of a 15th century master. But all these were only suggestions. Proof was still lacking. Then it was noticed that the embossed moulding around the panel was built up, from gesso, on a foundation of strips of some textile fabric, quite in keeping with the technique described by Cennino Cennini in his *Libro dell'Arte ;* but microscopic examination of a minute sample revealed the typical flattened, twisted fibres of cotton—a material which was practically unknown in Europe, as a textile, until several centuries later. Further, the fabric was of close and regular texture—a typical machine-made product. So far, so good ; but, granting now that the moulding round the panel was a recent addition, as modern as the underlying textile, might not the panel itself be genuine ? The answer was found by microscopic examination of the entire surface, whereby it was shown that the *craquelure*—that network of fine cracks that spreads over the vast majority of old paintings—ran without interruption over the surface of the moulding and on to the face of the panel proper. Hence, the faked modern moulding and the panel itself were contemporary.

German or Austrian manuscript of the 12th century.

Often, however, the best detective efforts of the scientist merely provide strong grounds for suspicion—not absolute proof. The dark green background of a so-called Holbein portrait was recently found, on microchemical and spectrographic analysis of a minute sample, to consist of Scheele's green, a copper arsenate discovered in 1778; but, though strongly suspicious, this might have been accounted for by recent restoration of the background, either wholly or in some damaged portion. This raises another question—that of selecting for analysis a really representative sample. This, again, is a matter on which the scientist is bound to turn for

information to the expert on craftsmanship; for the mere chemist might be inclined to condemn an entire work of art after analysis of a sample taken from a portion which to the eye of the art expert was obviously a modern restoration.

Scientific investigation of fine art problems is a young science, despite the excellent work of numerous investigators. It is still far from being an exact science, but the results obtained have been so encouraging that it is certainly a field in which systematic research will amply repay itself.

BIBLIOGRAPHY.

PROF. A. P. LAURIE: "*The Pigments and Mediums of the Old Masters*" (London, 1914). "*The Painter's Methods and Materials*" (Philadelphia, 1926). "*New Light on Old Masters*" (London, 1935).

DR. A. M. DE WILD: "*The Scientific Examination of Pictures*" (London, 1929).

J. J. RORIMER: "*Ultra-violet Rays and their Use in the Examination of Works of Art*" (New York, 1931).

R. J. GETTENS: "*Chemical Problems in the Fine Arts*" (Journ. Chem. Education, 1934, **11**, 587).

D. V. THOMPSON, Jr.: "*Il Libro dell'Arte*"—a translation from the Italian of Cennino Cennini (New Haven, 1933).

See also various papers in "*Technical Studies in the Field of the Fine Arts*," published for the Fogg Art Museum, Harvard University.

Lost Tribes of Malaya.

By D. McPherson.

In the mountain jungles of Malaya, within comparatively short distance of the sophistication of Penang and Singapore, dwell the remnants of the aborigines of the Peninsula. It is possible that these fast dwindling tribes are the relic of an ancient civilisation. Mr. McPherson gives some interesting particulars of their present condition.

SINCE the not-so-distant days of the pirates who lurked in the mangrove-fringed estuaries of the Straits of Malacca and who wielded the bloodthirsty *kris*, the name of the land which harboured them, "Tanah Malayu" in the vernacular, has spread far and wide. Tanah Malayu means the land of the Malays; but Malaya was not always "Malay land" for the Malays came from Sumatra. That was long before a ship from the West clove the waters of the Straits in quest of spices and the prized tropical produce for which Prince of Wales's Island—now Penang—became famous. Thus it was not even suspected until recent times that the Malay Peninsula had not always been the natural home of the Malay.

There are blank areas still on the map of the Malay Peninsula and it is there we find the lost tribes of Malaya. Living in the jungle-clad fastnesses of the mountains, they are very suspicious of intruders, and it is with difficulty that contact can be made and investigations pursued. Few have succeeded in learning much of the "Orang'Utan," or "Sakai" as these savages are called by the "Orang Kampong," or "village dwellers"—the Malays. Orang'Utan signifies "man of the jungle." But Sakai is a term used indiscriminately by the Malays to describe the aborigines of the country who are neither village-dwellers nor Moslem nor Hindu and it is incorrect in that there is a people to whom the name is specific. Among the few who have made successful expeditions into the interior in search of the Orang'Utan are Hrolf Vaughan Stevens, a traveller who, about thirty years ago, set out to study the Semang, one of the tribes of forest dwarfs, under the auspices of the Berlin Museum; Professor Dr. W. Schmidt, whose expedition was financed by Pope Pius XI; Paul Schebesta; and, more recently, Mr. H. D. Noone.

The Malay race is thought to have originated in Palembang and Manankabau in Sumatra and to have migrated about five centuries ago to the Peninsula, then the home of only the Semang, the Sakai, the Jakun, and the Senoi. As the Malays invaded the plains so did these tribes fall back into the interior and their distribution, so far as is at present known, is as follows. The Jakun, straight haired and akin to the Malay, occupy Southern Johore; the Sakai, a strange, primitive, and enigmatic race who appear to have originated in the Far East, now have their home in the mountainous forest country in the centre of the Peninsula; the Semang, negritos and probably the very first to inhabit Malaya, are now scattered between Southern Siam and North Perak; and in that practically unknown area where the boundaries of Perak, Kelantan, and Pahang meet are the Senoi, believed to have sprung from the same stock as the Mon-Khmers, the lost race who built Angkor Vat in Cambodia.

From where did these peoples come? What is their history? That we probably shall never know, but the little we have learned of them is sufficient to arouse the

keen interest of all seeking after knowledge of peoples whose past is lost and whose latter days are drawing to a close. That there should exist peoples about whom the world has learned little, although such unromantic things as motor-cars, railways, tin-mines, and all the paraphernalia of commerce may be observed by these very peoples from their jungle fastnesses, would seem to border on the fantastic. Nevertheless, it is so; then why not peoples as yet undiscovered still deeper in the unknown forest-girt mountains?

The Jakun are fast becoming civilised. They are daily more and more sophisticated and are being assimilated, in the spread of civilisation, into the commercialised and cosmopolitan community. The Sakai proper and the dwarfs, the Semang, retain a semblance of independence. Nomads of long habit, they roam through their territory but no longer from one "ladang" to another but rather from the borders of kampong to kampong as they lose their ingrained fear of the Malay

The Malay States, indicating the present distribution of the "Lost Tribes."

who, in days gone by, stole their womenfolk and persecuted the once numerous peoples of the jungle.

But the Senoi, a natural hill-dwelling people of a high standard of intelligence, ranking much above those other tribes whose habitat is, from necessity and

A Sakai Family.

not from choice, also the hills, remain in the recesses of their jungles. No longer do they assail the Malay kampongs with bow and arrow. Broadly speaking, all these peoples live similar lives and are similar in habits and customs. The Senoi differ, however, in living in semi-permanent dwellings and in following agricultural pursuits with hunting and fishing as subsidiary occupations. They live in communal houses as much as 80 and even 100 ft. long, although each family has its own cubicle. All the tenants tend the crops, but hunting and fishing are the concern of the individual families. One of their "taboos" will, perhaps, appeal to the Westerner. The Senoi husband must never meet his mother-in-law and turns his back upon her should she enter his house! Their religion, in common with that of the other people of the forest, is animistic, and what is known of their strict moral code shows the strange beliefs and practices of an enigmatic yet an intelligent race. In comparatively recent times they still used the bow and arrow, and it is significant that these arrows were iron-tipped. Now, however, the blowpipe, or "sumpitan," has superseded archery.

The Jakun build no buildings at all, or, at most, but flimsy shelters. That, of course, is in areas where the process of assimilation is not far advanced. The Sakai and Semang women build temporary huts, which remain the property of the women, and in their nomadic journeyings they must construct many in their short lifetimes. An encampment may remain for several months, possibly until such crops as have been sown are reaped, and then it is silently and suddenly vacated, leaving the camp complete except for inhabitants. It is not that the tribe flits to and fro between encampments, for, once vacated, a former encampment, or even the "ladang" upon which it stood, is never again made

use of. Indeed, two or even three clearings, possibly with ready-made dwellings upon them, may be within half a mile of the site of a new one.

These strange denizens of the jungle are as quiet as the jungle itself; one moment they are there, the next they are just "not." One of their gods is the God of Noise—Thunder. When Thor rumbles, as he often does in these latitudes, the women of the tribe lacerate themselves and throw the resultant blood, mixed with earth, into the air, confessing their sins and imploring the Thunder-God to cease. Should he not do so in a reasonable time—normally he does, for Malayan thunder-storms are usually of short duration although frequent and severe—then the men-folk join in similar supplication. And noise is an offence against the gods. When Mamma "Orang'Utan" becomes distracted by the row created by the tribe's offspring playing by the door of her shelter she calls out "Lawad Karei"—"a sin against the Gods"—and, immediately, silence reigns; until the next time! But Mamma really believes that to make undue noise, to play with animals or birds' eggs, to draw water with a soot-smutted vessel, to observe one's reflection while in the open air, to mock or laugh at things which cannot retaliate, or to do, say, see, or think, a number of other things—mostly sexual or inhuman and which if recorded in print would offend the susceptible Western eye—are very real sins. But then, Mamma, Papa and family are "savages." Equal to their uncanny facility for moving noiselessly through and about the choked tangle that is the Malayan forest are their amazing powers of observation and their dexterity with the blow-pipe, with the venomous dart from which your pigmy warrior thinks little of transfixing a thrush-sized bird on the wing at more than 60 yards. The dart poison, the prepared exudations of the "upas" tree (several of which each warrior has as his own private and unviolated property though they may be miles apart), is indeed a hell-brew. Simians as large as, and perhaps larger than, the marksman himself, when scratched by one tiny dart will be dead within two seconds of being hit.

A Semang Marksman.

There may be wars and feuds between these different jungle peoples, perhaps even inter-tribal bloodshed, but of that the outside world never hears. It is more likely that these forest dwellers are too busily engaged in wresting a meagre existence for their decimated and dwindling numbers from the alien environment into which they have been driven. Or, maybe, they are too wholly uncivilised to have thought of war. Their habits and moral code lend colour to this view, for adultery, theft, and crimes of violence are unknown to them or are but abstract ideas, which, to races that have no words for expressing abstract thoughts, amounts to practically the same thing. Simple folk though they seem to be it was nevertheless they who puzzled learned men the world over. An explorer returned to Europe with a few feathered arrows (the bow and arrow being known to all the present tribes) as specimens. These had the feathers cut short and sloping forward. Much discussion amongst the learned ensued and it was ultimately decided that Malaya's Orang'Utan knew nothing of the principles of arrow-feathering and probably feathered arrows from habit, and did so the wrong way because of "magic." As some arrows were, however, correctly feathered there remained an element of doubt. Years later, another explorer lucky enough to discover an old tribesman making arrows for the now obsolete bow asked the reason for the "wrong-feathered" specimens. Without a moment's hesitation the ancient replied, "Cut feathers whirr, they whirr more the wrong way—a whirring arrow stops a running pig with fear and thus he is hit."

We of the Western Malayan plains who gaze idly at the majestic hills, resplendent in the rays of the setting sun, might ask ourselves a somewhat similar question.

Jakun types.

What secrets of bygone peoples, of whom but remnants remain, could these forests reveal? What splendid history of a civilisation thriving when we of the West were but learning the meaning of civilisation? These straggling remnants of ancient peoples, now the despised Orang'Utan, cannot themselves tell us, but by picking up the threads before they are finally gone perhaps we should find that Romance is not altogether dead although it be of the past.

[AUTHOR'S NOTE. Professor Callinfels, the eminent Dutch archæologist, heads an expedition now exploring in Northern Malaya, the object of which is to investigate traces of the stone-age civilisation in the Peninsula first discovered 70 years ago by Mr. Earl, then Resident-Councillor, Penang.]

Cats and Catmint.

A correspondent of our contemporary, *Gardening Illustrated*, makes an interesting comment on the behaviour of the domestic cat. "Some years ago," he writes, "I gave up growing *Nepeta Mussini* owing to the damage done to it by our cat. The cat, a female, delighted in rubbing her head and neck on the plant, and at times rolling on it. This year I thought I would again try the plant, and at the same time bought and planted examples of *N. nervosa*, *N. ucranica*, and other species. All are untouched except *N. Mussini*, which the cat soon discovered and has practically destroyed. Occasional stray cats are seen in the garden, but as far as I have been able to observe, they ignore the plant. Moreover, I have noticed gardens in the neighbourhood edged with *N. Mussini* which, from its perfection, shows that no cats ever visit it, though cats are far from rare in the district.

Two questions arise: (1) Are male cats ever attracted to *N. Mussini*? (2) Are all cats attracted to *N. Mussini*, or is the desire to roll on the plant developed in only an occasional individual?"

The behaviour of cats is notoriously erratic regarding plants to which they are attracted, and we should welcome any observations on this point that may have been made by *Discovery* readers.

The Folk Dance and Science.

IN the popular revival of folk dancing there is a very real danger that interest in the spectacular and social aspects may tend to overshadow the importance of the scientific study of the dance, both as a basis of classic tradition, and as a valuable source of evidence, especially under the application of the comparative method, for the history of cultural development generally and with special reference to the peoples of Europe. In the International (European) Folk Dance Festival, which was held in London at the end of July under the auspices of the English Folk Dance Society and the British National Committee on Folk Arts, the balance was maintained by a conference on scientific aspects of the folk dance, which met daily at Cecil Sharp House, Regent's Park, under the chairmanship of Professor J. L. Myres.

The majority of the papers presented to the conference were of a descriptive character, illustrated with music and dance displays, and dealt with national or regional dances. In the displays of dancing great interest was aroused by the strangely magical effect of the Hobby Horse dance of the Calušari from Rumania; but each of the dances from other countries of eastern Europe, such as the "Lazarnica," the Bulgarian Lazarus dance, described by Mme. R. Kazarova (Sofia), could have served to illustrate and add point to the remarks of Dr. Elise van der Ven Ten (Netherlands) as to the degree in which the dance was a living element in the life of the people in Eastern Europe. In central Europe, as, for example, in Germany, it is a decaying art, or has virtually become extinct; while in north-western Europe it is a revived art, largely owing to the studies and activities of Cecil Sharp.

Other interesting examples of national dances, which were discussed, must be passed over, including Dr. D. J. van der Ven's film of Dutch traditional dances, with their "flagwaving," and Miss Violet Alford's comparative study of the relation of the morris to other seasonal dances of Europe and to the Morisca, of which publication will be awaited with interest. Mention, however, may be made of the study by Dr. R. Wolfram (Vienna) of sword and chain dances and his suggestion that these represent a dramatisation of an initiation ceremony, rather than the sacrifice of a central character as a fertility charm, as is generally held. Dr. Wolfram has now collected a great deal of evidence, additional to that on which he based his first enunciation of this theory, which he marshalled with much skill; but a criticism put forward on the ground that the initiation ceremony is never seasonal, as is the sword dance, is difficult to meet.

The Costly Nematode.

By Geoffrey Lapage, M.D., M.Sc.

Institute of Animal Pathology, University of Cambridge.

The ravages of the parasitic nematodes among domestic animals are hardly appreciated by the layman, and efforts to control these dangerous pests have so far met with very moderate success. Dr. Lapage outlines the methods which present research is adopting, and shows that here is a very fruitful field for physiological investigation.

THE nematode parasites of man and his domesticated animals must certainly be placed among the major menaces to our civilisation. Examples of these are the so-called "miner's hook-worm," once so serious a scourge of Cornish miners and still the cause of incalculable misery and thousands of deaths in America; the filarial worms that cause elephantiasis and other grave diseases of man in the tropics: and many species which afflict not only almost every kind of animal, but also such useful plants as wheat, barley, and the potato. Other species are not parasitic, but affect the work of man in various ways. Examples of these are the eelworms that live in vinegar barrels and the many species which inhabit the soil and by their effects upon it influence the work of agriculturists.

All nematodes are cylindrical and pointed at both ends; they are not, like the earthworm, divided into segments; their sexes are separate, the male being usually smaller than the female; they have a thick smooth skin unlike anything else in the animal kingdom, and peculiar muscles. They are built on a ground plan of two tubes, an inner one which is the straight alimentary canal and an outer one which is the skin and muscles, with a space full of fluid between. Embedded in the skin is a nerve cord along the back, another along the under side, with a smaller one along each of the sides; down each side runs also a tube which may be either a kind of kidney or, according to some authorities, an organ which helps the animal to liquefy the tissues on which it feeds or to prevent the blood which many of them suck from coagulating so that a continuous supply of liquid blood can be obtained.

Syngamus trachea, *the Gape Worm of poultry and other birds. It is found in the windpipe, male and female living permanently* in copula (*x* 10; *after* RAILLIET)

These nematodes that feed by browsing on the lining of the alimentary canal of their hosts have very efficient chitinous teeth. Those that suck blood may also have teeth with which they can make a wound in the wall of the alimentary canal. Authorities differ as to whether they feed upon this blood. The amount of bleeding they can thus cause is remarkable. Wells in America succeeded in actually watching a single nematode sucking blood in a loop of a dog's intestine and, by collecting the blood as it was passed out again by the worm, he calculated that one of these worms, which are only about half an inch long, removes from the dog about 0.8 c.c. of blood in 24 hours. If this rate of bleeding were maintained, each worm would remove about a tea spoonful every five days. It is not surprising, therefore, that the hundreds, and sometimes thousands, of these worms which may be present in man or animals can cause a profound and often fatal anæmia. Recent American work shows that this anæmia is directly due to the bleeding and can be cured, at any rate in the dog, by treatment with iron, after most of the worms have been removed.

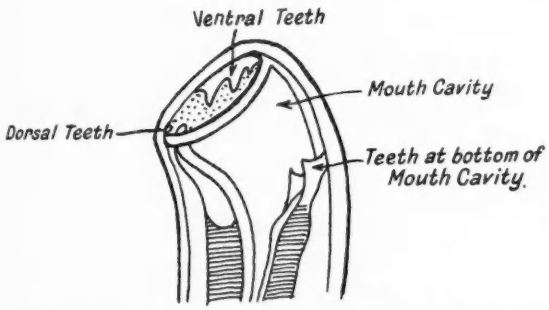
Nematodes are also accused of poisoning their hosts by toxins which they are said to produce, but this is nowadays doubted. There is much evidence that their hosts develop some kind of resistance against them which is not yet properly understood. In many respects the resistance developed by sheep and some other animals against some species of nematodes resembles the immunity that most animals develop against bacteria. It is being studied in the hope that it may be useful to the doctor and veterinary surgeon.

Not all nematodes live in the alimentary canal. Some inhabit the lungs and air tubes, the muscles, the kidneys, and other organs. The young of many of them enter their hosts by boring through the skin and then make complicated journeys through the body, perhaps causing pneumonia, aneurysms, colic, and so on, as they go, until they find some particular organ and grow to the adult state in that. One group of them, the filarial worms, inhabits the blood and lymphatic systems, often blocking these up and causing such diseases as

elephantiasis; these are passed from host to host by blood-sucking mosquitoes and other insects, in much the same way as the malarial and sleeping sickness parasites. The young of some nematodes pass part of their lives in snails or earthworms, which are eaten by the poultry or cattle in which the adult stages may cause disease. The adaptations of nematodes to the difficulties of these complex life histories are as beautiful and various as any shown by other animals.

Nematodes are not connected with the rest of the animal kingdom by any obvious links. They are an isolated phylum which seems to have diverged from the main line of evolution when this was about to produce the segmented animals, of which the earthworm type is the earliest example known.

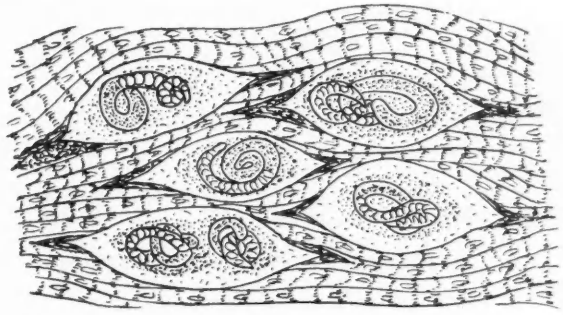
Some idea of the damage done by nematodes to farm animals alone may be gathered from Taylor's recent investigation of the severe losses sustained by farmers in England and Northern Ireland in the early months of 1934. Taylor found that 43 farmers in the Romney Marsh district lost £10,341 between January and April, 1934, from diseases caused in sheep alone by a few species only of parasitic nematodes, in addition to the



Side view of head of Miner's Hook-worm, showing the teeth (*after* R. HERTWIG).

losses from other causes for which these farmers usually allowed. The total losses due to nematodes in the whole of the Romney area must have been proportionately greater and the total loss in the whole of England and Northern Ireland very great indeed. It is therefore not difficult to believe authorities who state that nematodes cost the farms in Australia, New Zealand, South Africa, North and South America, and other countries, millions of pounds in hard cash; and if the poultry industry is included, it is evident that nematodes inflict very heavy annual losses on our civilisation.

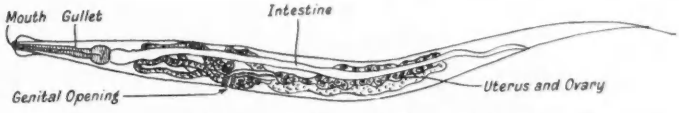
They are being studied in every land, but so far attempts to control them have not been very successful. We owe the virtual control of one species very harmful to sheep to the work of the South African Veterinary Research Station near Pretoria; but there is no certain remedy for nematode infestations of most of our farm



Trichinella spiralis *in voluntary muscle of a pig* (*from* FIEBIGER, *after* CSOKOR).

animals, nor indeed for those afflicting man. Recent work suggests that no remedy efficient against all nematodes will be found until we understand better the specific nature of a nematode. Very little is known of their physiology, nor of their physiological relationship to their hosts. If we could understand this, we could try to maintain the host and its parasites in the same kind of equilibrium as that characteristic of healthy wild animals, which survive although they always harbour many parasites. A method of control of this kind, based on nature's methods, would render unnecessary the expense and labour of drugs or other special methods designed to keep animals free from parasites. It is hard enough to keep human beings free from them, even with our civilisation and the authority of its law to help us; under farm conditions it is a hopeless task. All recent work, moreover, suggests that the more we coddle and control our domesticated animals, the more we may decrease their natural resistance to disease. The soundest and most economical methods will be to select and breed resistant stocks, to feed them properly, and perhaps also to dose them regularly with medicine which will not kill all their parasites, but may keep down their numbers so that the host can maintain a natural equilibrium with them.

[NOTE. A short bibliography appears on page 284.]



Enterobius (Oxyuris) vermicularis, *the human thread or pin-worm* (*from* BLACKLOCK *and* SOUTHWELL'S *Human Parasitology*).

The Ruins of Quiriguà.

The ancient Maya civilisation, its works of art, and its writings, have been occupying increasing attention in America. The latest expedition of the Carnegie Institution, described below, resulted in very important additions to our knowledge of the ancient inhabitants of Central America.

LAST year the Carnegie Institution of Washington, with the sanction of the Government of Guatemala, and with the financial assistance of Carnegie Corporation of New York, dispatched two members of its archæological staff, Mr. Earl Morris and Mr. Gustav Stromsvik, to Quiriguà, the site of the famous Maya ruins, for the purpose of re-erecting the fallen stelæ and of clearing the archæological site with a view to preserving the ruins and to bettering conditions for their study.

During the four months spent at Quiriguà, Morris and Stromsvik not only repaired and re-erected the fallen monuments but made systematic search for caches of ceremonial treasure that might lie at the base of the monuments. Also, they sought to learn what the methods were that the Maya employed in erecting the

The circle encloses the region once occupied by the Maya. The shaded area represents that occupied during the Old Empire Period, abandoned by the Maya in the 7th century and quickly overrun by tropical jungle.

monolithic columns which are such a striking feature of these ruins, the placing of which, on account of height and weight, must have presented serious difficulties to the ancient engineers.

In course of their work these investigators uncovered two hitherto unknown, exquisitely sculptured, altars which date back to an early period in Maya history. Among the sculptured monuments at Quiriguà are a number of unevenly rounded blocks of stone carved to represent animals, actual or mythological, such as the frog, the dragon, the serpent, the turtle. The largest of the stone animals is perhaps the most remarkable of all the monuments. It is a rounded bulk of brown sandstone, somewhat irregular in shape, weighing about twenty tons, and having a height of 7¼ feet, a breadth of 11½ feet, and a length somewhat under ten feet. In form and general appearance it resembles a huge crouching monster, with a seated human figure carved in deep relief in front, and a great grotesque mask behind. The various ramifications of the animal figure together with the intricacies of the sculptured ornamentation with which the stone is covered make it unique among the monuments of Maya origin.

It was while sinking a shaft from which to tunnel beneath this fantastically carved stone, called Zoömorph P, in the hope of finding a cache of objects of archæological interest, that Morris and Stromsvik came upon the first of the stone altars. It lay eighteen inches below the surface, about fifteen feet from the track leading from the railway to the temple court, and directly beneath the spot from which front-view photographs of Zoömorph P are usually taken. The second altar was found a few yards away, directly under the track, and in the same position in relation to another zoömorph.

During the centuries that have passed since Quiriguà was the centre of a teeming population, the backwash of the Motaguà river left a layer of silt over the lower portion of the ruins, completely burying these splendid examples of Maya sculpture but at the same time preserving them.

In describing the altars, Morris reports that they are great slabs of brown sandstone, somewhat unsymmetrical in form and carved on top and sides with compositions skilfully planned to conform to the outline of the slab. The dominant figure in each composition is that of a human form in dancing posture, elaborately clad, and wearing a huge complicated headdress with face mask. In each case, a long and delicately wrought inscription, with marginal serpent motifs, covers the remaining surface. Both slabs are exceptionally large,

one being nearly two feet thick, with surface dimensions 11 feet by 12½, the other slightly smaller. "In composition and execution," he adds, "the carvings are in the best Old Empire style. They rank among the masterpieces of Maya Art."

Soon after these altars were discovered they were examined by Dr. Sylvanus G. Morley, the Institution's specialist in study of Maya hieroglyphics. Dr. Morley found that although both altars carried dedicatory date glyphs these were too involved and intricate to be deciphered. However, he observed that a secondary series of glyphs, inscribed in the altar panels, corresponds to the dedicatory dates carved on the zoömorphs to which the altars belong. Morley therefore concludes that it is probable that in each case the zoömorph and its altar were dedicated at the same time, A.D. 531 in one instance, and A.D. 536 in the other.

Although search for ceremonial deposits was interrupted by the discovery of these altars, it was resumed and, indeed, under the very zoömorph near which the first altar was found, Morris and Stromsvik came upon a badly broken pottery box with cover; but, to the disappointment of the excavators, it was empty.

Search for such treasure, it should be said, is not altogether a haphazard procedure, for it was the practice of the Maya to place cherished objects at venerated places, presumably for ceremonial purposes. Thus objects of great archæological interest have been recovered from caches found at the top of sacred mounds, under temple floors and in temple walls, beneath altars, in burial vaults, and at the feet and in the foundation of monuments such as the stelæ and the zoömorphs of Quiriguà. Archæologists working in this field are therefore alive to the possibility of unearthing such deposits and so make systematic search in likely places when opportunity affords.

Zoömorph P, the largest of the stone "animals" at Quiriguà, weighing about 20 tons. Dedicatory date-inscriptions are carved on the panels surrounding the central seated figure.

In fact certain indications at Quiriguà suggested that careful search might well prove fruitful. A piece of flint chipping, for example, perhaps the most exquisite specimen of this art in existence, came from a mound against the back wall of a temple terrace about two miles north-west of the main group of ruins. It was uncovered by an Indian from a neighbouring village who declared he dreamed that if he dug at a certain spot in the mound he would come upon a great treasure. In five instances broken pottery boxes, rectangular in shape, were discovered underneath the Quiriguà monuments. They were from twelve to fourteen inches long and from twelve to seventeen inches high. Each was fitted with a pottery lid having a shape which Morris has likened to that of a mansard roof. All the boxes were empty except the one taken from under Zoömorph G. This contained a single large obsidian core from which knife blades had been chipped.

Although there was no box under Zoömorph B, a sheaf of seven blades and four small pieces of unworked jade stood embedded in the gravel paving beneath the monument. The blades, Morris reports, vary in length from 5½ inches to 18⅜ inches, are shaped like willow leaves, and are of superb workmanship.

Deep down beside Stela H a blade of similar shape, nine inches long, was found. Search of the lowest level of the clay-gravel paving under the foundation of Zoömorph O also revealed a quartz crystal, an unworked bit of jade, a jade face of superior workmanship, 1½ inches long, and a flint dagger, 8¼ inches long, with a handle fashioned to represent the body and head of the Plumed Serpent.

In re-erecting the stelæ that had fallen and placing them firmly upon concrete foundations, straightening those that were leaning, and fitting fractured parts together and dowelling them securely, Morris reports that he and Stromsvik experienced considerable difficulty, due to the heavy weights to be lifted and an equipment scarcely adequate to the task. In point of fact, one of the fallen shafts, the largest of them all, is thirty-five feet long and weighs upwards of fifty tons, yet such great shafts of stone were quarried from the mother ledge, transported a distance of at least three miles, and set up so firmly that to this day many have successfully resisted the strains and stresses of the passing centuries.

To assess the value of these achievements, it must be borne in mind that the Maya had no explosives, or metal tools, or beasts of burden, and that they were, it is believed, without knowledge of the wheel or windlass. Our amazement grows with the realisation that in the face of such handicaps enterprises were successfully undertaken that to-day tax the resources of men skilled in modern engineering practice and who at Quiriguà, in this instance, were equipped with derrick, handwinch, steel cables, and blocks and tackle.

Guatemala capitalises its antiquities by depicting them on its postage-stamps along with a coffee advertisement.

Although Morris, despite a minute examination of the monuments and of their foundations, was unable to find a clue to the methods employed by the Maya in handling the stelæ, he did learn the probable manner in which the shafts were quarried. The upper and vertical surfaces of a ledge were cut straight and smooth. Then a ditch across the ends and along one side, outlining the shaft, was dug to required depth. Next, the mass was undermined from back and front and cut through at regular intervals until the beam of stone remained poised upon and connected with the ledge below by a series of slender stumps which could be snapped off with levers. It was the presence of these "quarry stumps" on the butts of two of the stelæ that gave Morris the key to the method which these ancient workmen apparently used.

To-day the ruins of Quiriguà lie at the heart of an immense banana plantation. Twenty-five years ago the United Fruit Company obtained title to a vast tract of rich alluvial land in the valley of the Motaguà, splendidly suited to the growing of bananas. In clearing it of its tropical growth, the company, with commendable foresight, left untouched a 75-acre plot of virgin forest surrounding the ruins.

Arriving at Quiriguà station on the railway between Guatemala City and Puerto Barrios on the Caribbean Sea, the traveller soon learns that although there is a group of ruins about half an hour's walk north of the station, and another group about the same distance north-east, the principal site lies about two miles due east. A lane running through the banana plantation brings him to the remains of the tropical jungle that overspread the region when men abandoned it.

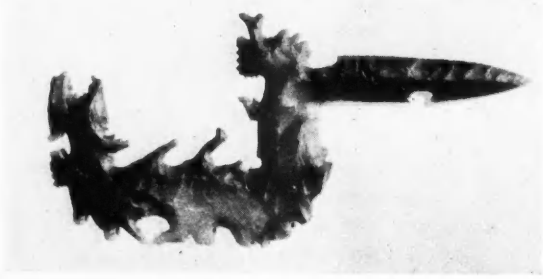
A short walk in this ancient forest and one comes out upon a partially cleared area, a quarter of a mile wide and half a mile long, the long axis running north and south. The archæologists call this the main plaza of the ancient site. Five distinct groups of ruins lie in and around this plaza, the most imposing of which is a little south and west of the plaza centre. This group, in turn, consists of a temple plaza, 140 feet by 160 feet, around the borders of which the ruins of six different structures are situated. In this same group there is evidence also of another and larger court with stepped structures on three sides and what appears once to have been a pyramid on the open side. Morley suggests that this pyramid may have been the scene of human sacrifice; and that the tiers of stone steps around the three sides were places where the people were

seated who came to witness the rites that accompanied these gruesome practices.

Of the sculptured monuments that have given this site its fame, there are nine stelæ, six zoömorphs, and six altars, of which the two recently found by Morris and Stromsvik are by far the largest and finest. Four of the zoömorphs and five of the altars are associated with the group of temple structures toward the south end of the main plaza; the remaining two zoömorphs, together with five of the stelæ and one of the altars, are near the group of ruins at the extreme north end of the main plaza; while the remaining four stelæ are located between the two points.

The wonders of Quiriguà and of the Maya region generally were first made known to the modern world by John Lloyd Stephens, who in 1839 was sent by President Van Buren on a diplomatic mission to Honduras. Accompanied by Frederick Catherwood, an English artist and architect, he visited every ruin in the Maya area of which he heard, travelling more than 1,200 miles through the jungle on horseback in so doing.

Not until 1881, more than forty years later, were efforts made to clear the ruins of the jungle growths that buried them. Then came Alfred Percival Maudslay, the English explorer and archæologist, who, within a period of thirteen years, visited the site four times, remaining three months on one occasion. During these trips Maudslay cut away the trees and underbrush near the monuments; took casts of the principal sculptures; and made photographs and drawings of the hieroglyphic inscriptions. It was Maudslay who at Quiriguà conducted the first serious scientific study of a Maya city ever undertaken; indeed, it was the publication of the great work covering his study of the monuments of Central America that convinced scientists that a pre-



Flint dagger found beneath Zoömorph O, with a handle representing the Plumed Serpent.

Columbian civilisation had developed in Middle America which was worthy of sustained study.

The conclusions reached by archæologists, based upon the study made by members of these expeditions, are

Stela E, the largest of the monolithic columns of Quiriguà, is 35 feet high and weighs over 50 tons.

summarised in a simple and interesting way by Dr. Sylvanus G. Morley of the Institution's archæological staff in his *Guidebook to the Ruins of Quiriguà*, published for the Carnegie Institution. In this non-technical account Dr. Morley sketches what is known of the rise of Maya civilisation; tells of the discovery and exploration of Quiriguà; describes in detail the structures that are there to be seen; explains the hieroglyphic writing that the Maya used in recording the dates they wished to preserve; and gives information about the site that will be helpful to the traveller who wishes to view for himself this splendid example of Maya craftsmanship. The book is illustrated with maps and many photographs.

Readers interested in the study of Maya glyphs, the decipherment of which is slowly progressing, are referred to the magnificent publications of the Maya Society, Johns Hopkins University, Baltimore, notably *The Outline Dictionary of Maya Glyphs*, by William Gates, President of the Society. Messrs. Kegan Paul, Ltd., are the London agents.

National Trust News.

NATIONAL Parks have been more or less under discussion since 1929-31 when the subject was investigated by a Government Committee, but no official action has ever been taken owing to the depression intervening. There is still, however, a strong popular demand in some quarters for National Parks, and it seems specially desirable that some action should be taken to preserve large tracts of country for the people to enjoy, especially near the big towns. Generally it has been supposed—and perhaps rightly—that establishing National Parks would be more than the National Trust could manage and that the task would have to be undertaken by the State and financed by the Treasury. This was prevented by economic circumstances and the National Parks remain an unachieved ideal. The areas the Government Committee considered likely to be suitable included the Lake District, the region known as Snowdonia, the coast of Cornwall, and Dovedale.

In all these areas the National Trust has a footing, sometimes a considerable one, so that a real beginning is being made towards securing land for the public in much the same way presumably as it would be secured if National Parks came into being. It is well known that the Trust has many properties in the Lake District and there is in addition a substantial acreage of common land and land reserved for water catchment schemes: in effect, therefore, the District is already a Park, for recent planning developments have led to the control of undesirable building and nearly all the lakes and fells are accessible for everyone to enjoy.

Preserving Rural Wales.

Snowdonia, on the other hand, has been less fortunate: plans for preservation are in preparation but are not very far advanced. In the meantime, it will be remembered that Mr. Clough Williams Ellis, Chairman of the Council for the Preservation of Rural Wales, offered to give 300 acres of his property on Nant Gwynant to the National Trust to be the nucleus of a National Park if others would follow his lead. It was announced on August Bank Holiday that this fine example had been copied by an anonymous benefactor who had presented the Trust with a large part of Aberglaslyn Pass. This generous gift is made the more valuable because several adjacent landowners have undertaken to put themselves and their successors under restrictive covenants which will obviate harmful development of their properties.

The coast of Cornwall, like the Pembrokeshire coast, is justly famous for its rugged beauty but it is in constant and growing danger of exploitation and disfigurement. The National Trust has saved several sections of it from time to time and now "Ferguson's Gang" (those mysterious friends of the National Trust) have offered to buy a part at Sennen Cove near Lands End. It is understood that several schemes are afoot for preserving other important points in North Cornwall.

The news about Dovedale is—once again—that a further gift has been made by Mr. Robert McDougall of Manchester. This most recent addition is in Upper Dovedale and consists of approximately 50 acres near Biggin Dale, a worthy accession to the Trust holdings thereabout.

A fresh announcement is made as we write. Lord Runciman has purchased from trustees and presented to the Trust nearly a mile and a quarter of foreshore and sand dunes on the Northumberland coast opposite the Farne Islands: to the south the gift touches Seahouses and to the north it stretches almost to Bamburgh whose grand rock-built castle is the most notable landmark in all that countryside.

The Trust in East Anglia.

Though the National Trust is not well represented in East Anglia, its three large nature reserves, within convenient reach of Norwich, will be of special interest to members of the British Association. These are:

1. *Scolt Head*, near Holkham, an island of 1,200 acres or so of sand dunes, salt marsh and shingle ridges with large colonies of terns. This is also a haunt of many waders and is visited by a great variety of migrants. It is of almost equal interest to botanists and geologists.

2. *Blakeney Point*, about the same area of shingle spit, and the haunt of almost the same birds. The vegetation is again interesting, and a little different from Scolt Head.

3. *Wicken Fen and Burwell Fen*, between Cambridge and Ely, 618 acres of fen of great interest for its insect, plant and bird life. The Swallowtail may be seen in great numbers and the Dutch variety of the Large Copper Butterfly was successfully introduced. The water level has been very low for the past two years.

The Secretary of the National Trust writes: "East Anglia is so rich in fine old buildings that I hope we may have more soon, while the beauties of the Breck country have been much in our minds lately, and I am certain we have an important part to play in its preservation. Though some people in East Anglia want it to be saved by a local body, I am sure the support of a national body is needed."

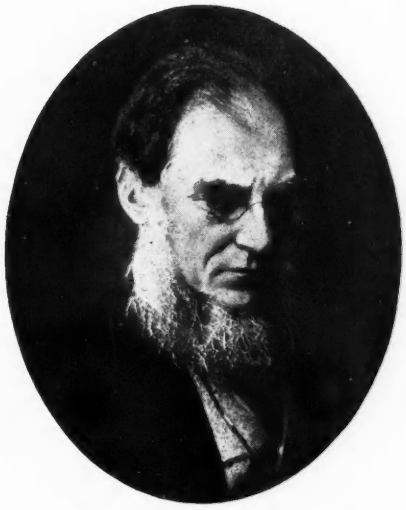
An idea appears to be prevalent that only large subscriptions are acceptable to the National Trust. This is far from being the case, and all contributions will be welcome at the offices, 7, Buckingham Palace Gardens, London, S.W.1.

Joseph Hooker and the British Association.

By John S. L. Gilmour, M.A., F.L.S.
Assistant Director, Royal Botanic Gardens, Kew.

In 1868 the Darwinian controversy was still at its height, and Hooker, in his Presidential Address to the British Association, was glad to devote himself mainly to the burning question of the day, both as a friend of Darwin and as a man of great modesty regarding his own achievements. Some of the points at issue still remain under dispute, and Hooker's judicial way of approaching them is a model to all concerned.

THIS year the British Association meets at Norwich for the first time since 1868. On that occasion, sixty-seven years ago, the gathering was presided over by Dr. Joseph Hooker (Sir Joseph after 1877), who had recently succeeded his father as Director of the Royal Botanic Gardens, Kew, and who was then in the full tide of his amazingly long and fruitful career. It may be of interest, therefore, to recall the presidential address that he delivered and to consider it briefly both in the light of scientific thought of that period and in relation to developments that have taken place in the succeeding years.



Sir Joseph Hooker (1817-1911).
[*Royal Botanic Gardens, Kew.*

Hooker, perhaps more than any other botanist, was born and bred in an atmosphere of science. His mother's father was Dawson Turner, the well-known writer on seaweeds and co-author of *The Botanist's Guide*. His paternal grandfather was also a keen naturalist, while his father, Sir William Hooker, was Professor of Botany at Glasgow during Joseph's most impressionable years. Sir William owned a large private herbarium. "New species must have been almost daily under examination, often as living specimens. . . .The eye and memory must have been trained almost unconsciously. . . .Few ever have known plants, few ever will know them, as Joseph Hooker knew them."* It is small wonder, therefore, that Hooker was first and foremost a scientific worker. The life of an administrator and public man never appealed strongly to him.

When, therefore, the office of President at Norwich was offered him he was loth to accept it. He wrote to his close friend and constant correspondent, Darwin, "The fact is that I have an insuperable aversion to high places; the acceptance would have been bad dreams in anticipation for 18 months, and a downright surgical operation at the end of it! I believe I inherit this from my father, who never would put himself forward, or be put forward, and I am sure it *paid in the end.*"

Eventually, however, he was induced by his friends to accept, but for some time was unable to make up his mind what subject he should choose for his address, as is shown by the following extract from another letter to Darwin: "I get more and more unhappy about the Address as the time draws on. Nothing on earth would induce me to do a thing so *damned indelicate* as to force such a position on an unwilling soul. Science might go to the Devil before I would do so by an enemy even. You see I am working up myself to the starting point."

He played with the idea of tracing the history of botany down the ages, or of giving "a dilatation on the correlation of Botany with other sciences," but he found that he could not "possibly give the three clear weeks of continuous application that such subjects demand." Finally, he wrote to Darwin: "I have sketched out a sort of see-saw discourse on several subjects that are germane to the Association and the Norwich Meeting par excellence: some of them are practical (as Museums), others theoretical, as the influence of your labours on Botany—and Pangenesis (God help it)—others touch 'Tom Tiddler's Ground,' as the early history of mankind apropos of religious teaching and the International Prehistoric Congress."

The final result of these rather luke-warm preparations was not a great or epoch-making address, but coming

* Professor F. O. Bower.

from one of the foremost men of the Victorian period and dealing with some of the most important scientific questions of the day, the Norwich Address is a document of considerable historical value

After some preliminary remarks, largely of a personal nature, including a tribute to the veteran geologist Adam Sedgwick, Hooker touches on the investigations then in progress on the Khasia tribes in Eastern Bengal, and their remarkable megalithic monuments—a subject to which he had paid particular attention when, eighteen years before, he made his famous journeys in the Himalayas. Hooker's knowledge of many branches of science other than botany was very wide. His surveying work during his Indian travels would have won him fame in the scientific world if he had made no botanical collections whatever.

There follows a diatribe against the deplorable condition of the majority of museums at that time and a plea for their improvement and increased use by schools, where facilities for biological teachings were practically non-existent. If Hooker were alive to-day the vastly increased importance of biological teaching in our schools would delight his heart, though he would undoubtedly be in the forefront of those who press for an even wider application of the biological outlook throughout the school curriculum.

The Advance of Botany.

Turning to recent scientific work, Hooker refers to the researches of Binney and Carruthers on carboniferous Calamites preserved in coal balls, whereby it was definitely proved that these giant plants were the ancestors of the humble horsetails (*Equisetum*), one species of which is well known to gardeners as a troublesome weed in light soils. To-day this group of plants comprises only some 25 species of lowly herbs, whereas at the time when our coal beds were laid down their ancestors formed forests of noble trees and were one of the chief features of the vegetation. Apropos of these researches, Hooker laments the lack of well-preserved flowering and fruiting material in fossil plants, and points out the dangers of relying too much on identifications made from leaf impressions only. He quotes an amusing anecdote in this connection. A learned and renowned fossil-botanist had referred three leaf impressions to plants belonging to three separate and distinct families and had based important conclusions on this evidence as to the past distribution of the families. Later it was shown that these impressions were of three leaves from the same plant, namely, the common blackberry, which still grew on the spot! Since Hooker's time, however, great strides have been made in the study of fossil flowers, fruits and seeds. It is now possible to study under the microscope the cellular structure of fossil reproductive organs which have been "dead and buried" for many millions of years. Further, similar technique enables the palæobotanist to examine the microscopical structure of the cuticle of carbonised leaves and thus to render their identification much more reliable than by the comparison of their outline and veining alone. The science of palæobotany to-day has indeed travelled far since Hooker stated at Norwich that "In this most unreliable of sciences—Fossil Botany—we do but grope in the dark; of the thousands of objects we stumble against, we here and there recognise a likeness to what we have elsewhere known, and rely on external similitude for a helping hand to its affinities; of the great majority of specimens we know nothing for certain and of no small proportion we are utterly ignorant."

A Tribute to Darwin.

From fossil plants Hooker then turns to a review of Darwin's contributions to botany during the previous ten years, that is, since the first publication of the "Origin of Species" in 1859. The list is an imposing one and reveals Darwin's minuteness and accuracy of observation which, together with his power of broad philosophical generalisation, made him perhaps the greatest scientific figure of his century. The first work mentioned by Hooker, "The Fertilisation of Orchids," gives a fascinating account of experiments on insect pollination in this group. Hooker says of this work "It is not too much to say that it has thrown more light on the structure and function of this immense and anomalous family of plants than has been shed by the labours of all previous botanical writers" Further, it paved the way for research on similar lines by other workers. Perhaps one of the most striking stories of the relation between orchids and insects is that of three species of *Ophrys* (the same genus to which our bee and fly orchids belong) which occur in the Mediterranean region. (A full account was given by Col. Godfery in the *Journal of Botany* for February, 1925.) Each of these species is pollinated by the males of certain species of bee, which alight on the lip of the orchid and perform the movements of fertilisation exactly as if the orchid lip were a female bee of their own species. In doing so they remove the pollen from the orchid and transfer it to the stigmas of the next plant visited. No other attraction, such as honey or edible tissue, exists and these males are apparently under the impression that they are paying their attentions to a genuine female bee, though, to our eyes, there is exceedingly little resemblance between the lip of the orchid and the body of the bee. Col. Godfery observes that "Nothing short of

seeing this with my own eyes was sufficient to dismiss all doubts from my incredulous mind."

Darwin's well-known researches on the pollination of the primrose, cowslip, and common loosestrife are next mentioned, followed by an appraisal of his work on climbing plants, the ascent of sap and the formation of wood. Lastly, his latest work "On Animals and Plants under Domestication" is alluded to, special reference being made to his hypothesis of Pangenesis. This theory postulated that each cell of very plant or animal contained millions of "gemmules," each of which was present in the original fertilised egg giving rise to the organism and which had been distributed throughout the body of the organism by constant multiplication during development. These gemmules Darwin stated were responsible for the various characters of the adult plant. This theory, which was hotly debated at the time, is now of interest chiefly as a "museum piece." It may be said, however, to have contained the germ of the idea of the transmission of characters by genes situated in the chromosomes which, since the beginning of this century, has revolutionised our concepts of heredity and variation. Hooker's summing up of Pangenesis in his address as an hypothesis which "certainly correlates, and may prove to contain the rationale of all phenomena of reproduction and inheritance" is one which has well stood the test of time.

Natural Selection.

Hooker now turns to the Darwinian theory of Natural Selection and attempts to assess its position as a scientific hypothesis after its first ten stormy years of existence. At the date when he was speaking, Natural Selection was very widely accepted by biologists, especially by the rising school of workers. From its early struggles it had definitely emerged triumphant, and Hooker's remarks are directed chiefly against a few remaining dissentient voices, notably those of theologians, geologists, and astronomers, to all of whom he uses reasoned arguments to dispel their doubts. The history of Darwin's theory is an interesting one. Its almost fanatical acceptance during the second half of the nineteenth century gave way, under the criticisms of De Vries, Bateson, Willis and others, to an almost as complete rejection during the early years of the twentieth. The pendulum has now swung back again, fresh stimulus being derived from the statistical and mathematical analysis of the mechanism of selection by Fisher, Haldane and other workers. As it becomes increasingly clearer that evolution is the product of not one but many "causes" working together, it seems likely that Natural Selection will fall into its rightful place as one of the most important of these causes, to be carefully studied along with the rest, but not to be exalted as the ultimate driving force of evolution.

However that may be, its greatest service was undoubtedly that, by suggesting an easily understood theory of evolutionary change, it once and for all killed the conviction that every species had been separately created, and enthroned the doctrine of gradual evolution in the very centre of human thought. And in the early struggles against prejudice and bigotry, Hooker, with T. H. Huxley, played a part which will live for ever in the annals of science.

A Living Controversy.

To conclude his address Hooker touches on what he described to Darwin as "Tom Tiddler's Ground"—the relationship between religion and science. This subject is fresh in the minds of readers of *Discovery* owing to the recent correspondence that has taken place in its columns between Dr. Alfred Noyes, Dr. Julian Huxley and others. At the time of Hooker's address the controversy between theologians and biologists over the origin of man and the accuracy of the first chapter of Genesis, though not at its most bitter, was still sufficiently acute. Hooker must have been exceedingly weary of it all and hence we find him endeavouring to pour oil on the troubled waters. "Let us each pursue to search for truth," he says, "the archæologist into the physical, the religious teacher into the spiritual history and condition of mankind." This attitude, implying the division of vital phenomena into two water-tight compartments, one cannot help feeling was dictated by the tactics of the moment and by a desire for an armistice from battle, rather than by a sincere conviction that such a course served the best interests of the pursuit of truth. Indeed, in the same address, he says, "to separate them—the physical and spiritual aspects of the history of man—is, I believe, indeed impossible, but to search out common truths that underlie both is permitted to all." There, surely, speaks the real Hooker, who saw clearly that the true meaning of science is a method of thought, an approach, which can be applied equally well to spiritual and material things.

This article, however, is not the place to enlarge on questions of such fundamental importance. We have glanced briefly at these comments on various aspects of 19th century science by one of its leading exponents. To those readers of *Discovery* who are attending the British Association meeting at Norwich this year, it may be of interest to compare the state of scientific knowledge and opinion as revealed in the various sectional discussions, with that expressed in Hooker's address of sixty-seven years ago.

Television and the Future.

By H. Warren, M.I.E.E., M.I.A.E.
British Thomson-Houston Research Laboratories, Rugby.

By courtesy of the Editor of THE ELECTRICIAN *we are able to publish this admirable survey of the position of Television to-day and of its possibilities in the future. Mr. Warren has recently returned from a visit to the United States, which, combined with his knowledge of what is being done in Germany, enables him to draw some interesting comparisons.*

IN all Nature may be seen disinclination to interference with the normal rate of change; evolution is a very slow process. A new organism introduced into an environment unsuited or unready for its development is liable to stunted growth.

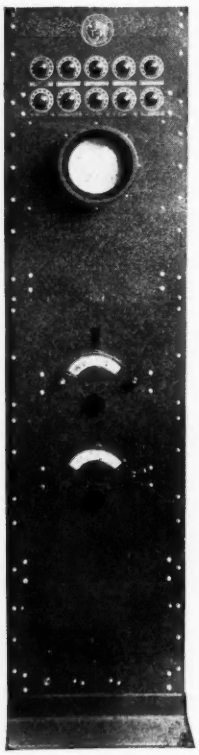
The moving picture had to wait for the coming of the continuous photographic film. The talking film was invented long before the day in which it could flourish with the technical stimulation of the solution of problems associated with the rocket-like rise of radio reproduction. Broadcasting itself awaited the impetus of the thermionic valve. Innumerable inventions have been "before their time," many of them, in particular the early ones, came when technical conservatism was strong and developmental resource was weak; commercial possibilities were less clearly and courageously visualised, and the new ventures were often the product and concern of individuals facing the traditional difficulties of lonely pioneers.

Such inopportunity and loneliness, however, do not altogether characterise the position of the television stranger-guest now being received with mixed feelings into the family of industries interested in communicating and portraying things to the public through the media of sound and sight; times also have changed so that almost any good proposition can be perfected technically.

The newcomer, though by no means in its infancy, is admittedly still in some respects rudimentary, having features to be developed and worked out commercially.

In British television, fortunately, we have neither the overpowering political incentive of German television nor the advertisement and largely business aspect of the American television situation. The one is pressing forward and the other holding back—both for excellent local reasons.

The American situation is very interesting. On the laboratory scale, as in some British laboratories, experimental television is a beautifully accomplished fact, but most authorities are in no great hurry to launch it upon the American public until more experience of transmission and reception in the field has been obtained, and until the probability of popular enthusiasm seems without doubt. This is especially so whilst sound broadcasting is satisfactorily sponsored largely by advertisers, and the radio set industry is valiantly holding its own in the depression still lingering in America. It is, to some extent, as if there were, say, a gramophone industry in which records containing a dash of advertising matter, some serious talks, and a generous amount of entertainment were given away by the advertisers; the records would be designed and distributed mainly to popularise the goods advertised and to promote the sale of gramophones. Any modification to the records widening their performance range, but making them more complex and costly, less easily distributed, and involving the use of more expensive gramophones would be more simply a matter of commercial consideration than is the British parallel, where the records have no advertisement value, but are sold by the Government with the principal idea of providing the public with the best and the latest, and the gramophones sold by the trade have to be devised to get the best entertainment value out of the records distributed. The American situation is almost entirely between the trades and the public, but, in Great Britain, the Government occupies an impartial but dominating corner position in a triangular situation.



Experimental television receiver for laboratory use.

In listening the other evening to an excellent commentary upon a championship fight, the writer was impressed by the feeling of how much the interest and pleasure would be increased by seeing, as well as hearing about, the performance. Such a thing is to-day technically

possible, within limitations that will be overcome in the course of experience and development. There is no technical reason why, in a few months' time, people all over London and Greater London should not be able to look and listen in. The outstanding difficulty is financial. The cost of the televising rights for the fight would have to be such as to compensate for the loss of cinema rights. This is typical in the general field of reproduction of animated pictures of daily items of public interest, and it must be remembered that individuals pay a great deal more per hour of cinema entertainment than per hour of radio reception. It looks as if the television programme builders will have to break new ground, just as the cinema interests will have to keep ahead.

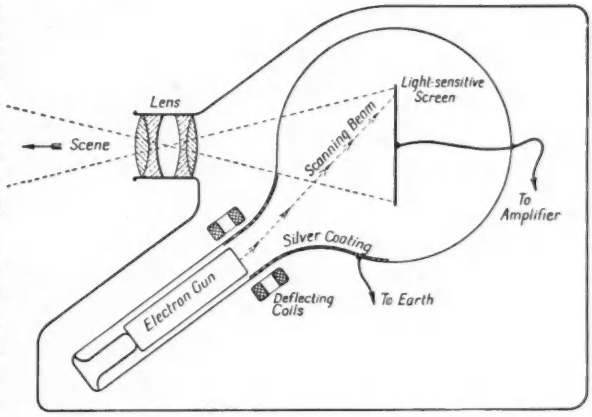
The success of public television depends upon the technicians engaged upon picking up, transmitting, and receiving, producing results within the economic reach of the public comparable in quality with those high standards to which listeners have become accustomed. Such success will naturally be a process of development in the field, following upon extensive laboratory work; the arrival of the receiver price element at the lower levels coincidentally with the achievement of optimum quality is not yet in sight.

The nature and quality of the programme itself is as important as the technical fidelity of its reproduction. Naturally, film proprietors cannot have new films broadcast until their box office return has materialised, and a programme made up of an ancient film, some specially made shots of the Houses of Parliament, and a studio cornet player would, to take a horrible imaginary example, be fatal to the popularity of television. However this may be left safely to the B.B.C., whose experience and standards of programme building, and knowledge of the respects in which present Continental television programmes are susceptible to improvement, may be relied upon to result in presentations in line with public approbation. Of course, the amount of money available is of prime importance.

Television and the Cinema.

The cinema and the theatre will always have their advantages of being enjoyable objectives of attractive excursions, of affording opportunities of meeting friends, of palatial comforts, large scale productions, personal appearances, and first-hand music. Television also eventually may well link the cinema screen directly with selected world happenings, the interest in which may be enhanced by the virtual elimination of time lag. Here again this is technically accomplished, and can be seen in Germany.

Meanwhile research marches forward. Leading British radio manufacturers are alive to their responsibilities to their customers. They are providing ever better products and service to enable the listening public to get more enjoyment from the 'audio' programmes that will continue to be the principal attraction of broadcasting, and will be ready to cater for those who wish, in addition, to see such 'video' items as may become available.



Diagrammatic representation of the Zworykin Iconoscope Tube, showing the electronic scanning system.
From Scroggie's "Television," by courtesy of Messrs. Blackie & Son, Ltd.

The pioneer work of Baird (Baird Television, Ltd.), whose name will always be foremost in the history of television developments, with low and high definition disc scanning, and the more recent contribution of Zworykin (R.C.A. and Electrical and Musical Industries, Ltd.), with his photo-electric mosaic and electronic scanning (iconoscope), provide apparently the alternative methods of picture pick-up of interest in British television transmission at the moment.

As regards disc scanning, in the television section of the Research Laboratory with which the writer is associated, there is experimental high definition scanning equipment, and with 180 lines and upwards (25 pictures) the results obtained are well up to the best corresponding receptions to be seen abroad. They are bright, steady (having regard to the picture frequency), the elimination of distortion is satisfactory, the definition is good, and those who have not seen such experimental high definition television reception would be surprised at the comfort and interest with which the pictures may be viewed in a semi-darkened room. The particular laboratory transmission referred to is over short lines, and so the radio interference to which radiated transmissions can be liable does not have to be contended

with. The scanning of films is simplified by the fact that the vertical motion of the film eliminates the necessity of vertical scanning, and fidelity of both picture and sound reproduction is good.

The iconoscope camera, which is said to be capable of definition up to 500 lines, and to be as sensitive as a photographic plate, is a remarkably compact, convenient and adaptable device. It is no larger than a studio camera and is handled with comparable facility. The iconoscope tube receives the photographic image of the subject or films to be televised upon its mosaic. The image is produced by a camera lens mounted outside the iconoscope tube, and can be viewed quite clearly and conveniently by means of a reflex mirror arrangement. The mosaic screen is made up of millions of isolated photo-sensitised elements upon a mica sheet, at the back of which is the metal signal plate constituting a common conductor with which each of the separate photo-electric elements co-operates to form a condenser. The picture signals transmitted from the camera are the succession of discharges from the elemental condensers of the mosaic as the discharging cathode ray beam scans them The value of the current discharge from each element depends upon its illumination and the time that it is covered by the cathode ray. Thus, with constant velocity scanning, the successive signal strengths are proportioned to the corresponding light and shade areas of the image focused by the lens upon the mosaic.

To think about the iconoscope is to visualise one of those wonderful ideas that seem almost too good to be true. To consider one in operation is to realise the practical genius of its constructor. The camera can be pointed out of the studio window, and the cars and passers-by in the street can be seen clearly in its reflex mirror and on the distant cathode ray screen. If the camera is turned round and focused upon a person under the studio lighting, his features are transmitted with remarkable sharpness and fidelity of detail. Here, indeed, is the electric eye.

Transmission.

Relatively recent developments in radio communication have made possible the transmission of the necessarily high picture modulation frequencies impressed on carrier waves between 4 and 10 m. in length, with sufficient uniformity and room within this waveband (30 to 75 million cycles) to accommodate several independent high-definition sound and picture channels without overlapping or interference. A difficulty is, of course, the limited range of these ultra-short wavelengths, as we are dependent upon the direct waves propagated more or less parallel to the earth's surface. They differ from the longer wavelengths which may be transmitted over great distances by reflection from the ionised layers surrounding the earth's atmosphere, in that they apparently pass through these layers, and, therefore, only the direct waves from the antenna can be picked up on the earth's surface, and then not far beyond the horizon. This, of course, means that a television reception area will be relatively immune from interference from other distant television, and it is fortunate that atmospheric interference is practically non-existent. Interferences of artificial origin, however, such as that from diathermy apparatus and the ignition systems of motor-cars, aeroplanes, etc., have to be reckoned with, and suitable radio interference suppressors will have to be employed more universally than at present. The writer saw television receptions in Berlin which were completely spoiled by "rain" during the periods in which a neighbouring medical man was operating his high-frequency apparatus, and recent reception in New York was considerably interfered with by the ignition apparatus of passing aeroplanes. In Berlin the interference was conducted along the mains to the receiver, whilst in New York it was radiated and picked up directly on the aerial.

Reception.

The cut-off or attenuation of television signals, due to intervening obstructions, such as the framework of buildings, overhead wires and other absorbing media, may have to be avoided by the erection of high receiving aerials, and these will have to be connected to the receivers by means of special feeder systems to eliminate attenuation and induced interference from adjacent circuits. In favourable conditions, however, a rigid vertical conductor only a few feet in length, and connected at its base to the receiver, may suffice. The separation and amplification of the two carrier frequencies received may be simplified by using the well-known superheterodyne method of amplification; special valves are being developed suitable for direct signal amplification at the ultra-high frequencies, and it may be expected that the ultra-short wave sound transmissions will stimulate further perfection of sound-reproducing apparatus.

Public television has been promised and pushed for at least two or three years in Berlin, but although two or three technically good 180 line 35 picture transmissions per day are broadcast, and the general public can see and hear reception free at half a dozen demonstration halls, the television receivers are not to any extent in public use, and indeed the subject matter of the pro-

grammes (mostly old films, propaganda, and a small proportion of special films) is not of a standard generally acceptable to British ideas. In America public television, except on a fragmentary and intermittent basis, is non-existent.

Here we may be sure that the B.B.C. will give only of the best—not beginning so soon perhaps as was at first anticipated, but it must have learned much from its pioneering of low definition broadcasting with the Baird Co., and from its high definition broadcasting experiments with this company and with the Marconi-E.M.I. concern. So we may expect, in due course, a standard of British television that will interest those listeners who can afford to equip themselves to see the television which will supplement the sound programmes. Naturally, for some time to come, television will be a novelty interlude in the regular audible programme, receivable only in the London district. National television must be some time ahead.

The necessary darkening of the room for television reception is a disadvantage, the small size of picture and probable necessity for a special aerial are also drawbacks, the acceptance of which will have to be made worth while by the technical and subject excellence of the reception.

The introduction of television into the home may thus have the appearance of being a little venturesome at first, but it may be stated safely that, behind the scenes, those interested in programmes, transmission and reception are concentrating their resources and experience on the ultimate inception of a television era in keeping with the traditions of British Broadcasting. Brighter, steadier and larger pictures, greater reliability, simplicity and convenience of operation are requirements fully realised, whilst yet high definition television has never properly been shown to the general public.

The author is indebted to his colleague, Mr. T. H. Kinman, for assistance in the preparation of this article.

A Television Handbook.

Television, by M. G. Scroggie, B.Sc., A.M.I.E.E., in Blackie & Son's "Technique" Series (3*s*. 6*d*.), is a useful elementary handbook on the subject, appropriately issued to follow the publication of the Report of the Postmaster General's Television Committee, which has given an official status to television.

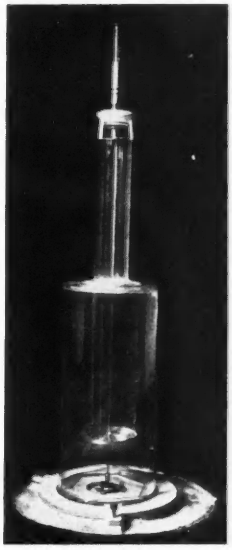
This book has been written to satisfy the demand for a simple explanation of how television systems work. By omitting much that the Report renders of little practical interest, it is possible to give special attention to those systems that have been officially recommended for public service. It gives a clear idea of underlying principles; some account of the systems now being developed—their present results and future potentialities; the nature of programme and other services; and the scope for experimentation and new developments.

Seeing Land-Waves.

By G. Radford Mather.

THE instrument illustrated in the attached photograph, known as the Zenith-Nadir Instrument, is intended to show land-waves caused in the earth by the earth's rotation on its axis, by its revolution on its orbit round the sun, and by the force exerted by the revolution of the moon round the earth.

The construction of the instrument is as follows. At the bottom are two cast iron plates, the lower one bedded with cement on a tiled floor, the upper one loose, with three levelling screws. On this upper plate is fixed a glass cylinder 7 in. in diameter and 14 in. high; on top of this is fixed a similar glass cylinder $2\frac{1}{2}$ in. in diameter and $10\frac{1}{8}$ in. high. Covering the last is a disc, with a round hole 5/64 in. in diameter. In the centre of the two cylinders is a pointer $24\frac{5}{8}$ in. long, the lower portion of which is of brass 14 in. long and the upper of aluminium. The rod is $\frac{1}{8}$ in. in diameter except at the top, where its diameter is 3/64 in. From beneath the cover of the larger cylinder three silk cords $10\frac{1}{2}$ in. long suspend a brass disc 4 in. in diameter; this has a hole in its centre rather more than $\frac{3}{8}$ in. in diameter. The brass disc weighs 12 ounces and acts as a plummet. Through its centre the pointer passes, standing vertically, and on the pointer $3\frac{5}{8}$ in. from the bottom is fixed a brass ball $\frac{3}{8}$ in. in diameter, whereby the effect of any horizontal force actuating the pointer is increased eight times at the top end of the pointer. The pointer stands in a brass cup, containing watch oil, fixed in the centre of the 7 in. base, and the brass ball mentioned above is likewise lubricated with watch oil. The magnifying lens at the top of the upper cylinder enables the movements of the pointer to be seen in greater detail.



The Zenith-Nadir Instrument.

[Mr. Radford Mather has a strong claim to be *Discovery*'s oldest reader, as he is over 90 years of age and has read the paper since its second number. The construction of the delicate instrument described above shows that his hand and eye are as skilful as ever.—ED.]

Book Reviews.

New Light on Old Masters. By A. P. Laurie, M.A., D.Sc., LL.D. (Sheldon Press. 6*s*.)

That the old method of learning the craft of painting by apprenticeship to a Master is no longer practised is deplored by none more than by painters themselves who, *faute de mieux*, pick up what practical knowledge they have as they pass, or are hurried, through their course at the art schools. Moreover, this knowledge for the most part stops after the technique of putting paint on to canvas or panel has been acquired, and does not include a concern as to *what* paint or *what* panel; and there must be thousands of painters to-day, otherwise extremely competent, who have never primed a canvas and who are virtually not interested in the chemistry of their pigments, whose work is destined to darken and crack through lack of care or through sheer ignorance. The ethics of selling goods which, through weakness in their manufacture, may deteriorate and cost their owners money for repairs and renovation, are open to question, but this is precisely what is done to-day by many artists who, interested only in expressing their precious emotions, find the necessary limitation of materials irksome. They forget that the restricted palette is in itself a stimulus, and stretch forth eager brushes towards the many new pigments which modern chemistry has produced, without pausing to enquire into their ingredients and their possible reaction on each other.

Even those who think that a too-close study of the chemistry of paint results in overstressing the importance of technique and acts as a drag on the free expression of the artist, are bound to admit that the history of art must inevitably be linked with the development of technique; and now Professor Laurie, whose books on the scientific aspect of painting take their place alongside those of Vitruvius, Pliny, Cennino Cennini, and Sir Arthur Church and should be in every artist's studio, has published what he describes as "the history of painting as seen through the windows of a chemical laboratory."

In this interesting account of the methods employed by painters through the ages, the whole field of colour preparation and application is surveyed, from the simple earth powders and gum arabic medium of the Egyptians to the pigments and technique of the French Impressionists and the paintbox of to-day. There is a chapter on Cennino Cennini and tempera painting, recalling some of that naïve writer's delightful instructions—"I give you this urgent advice, to make an effort always to embellish with fine gold and with good colours, especially the Figure of Our Lady, and if you wish to reply that a poor person cannot make the outlay, even if you were not adequately paid, God and Our Lady will reward you for it body and soul," and "You must know painting on panels is the proper employment of a gentleman; and that, with velvet on his back, he may do what he pleases." In his discussion of the Brothers Van Eyck and the invention of oil painting, Professor Laurie notes the doubt that has been thrown on the existence of the elder brother, and makes the daring suggestion that it is in England that their immediate predecessors, from whom they learnt their craft, are to be found.

While those parts of the book which deal with the technique of Rembrandt and the Dutch "Little Masters," of Turner and the Pre-Raphaelites, of Rubens and Frans Hals, should enable one to approach their pictures with a new enlightenment, it is in the last four chapters that the most exciting new material is to be found, for here is told how the microscope, X-rays, ultra-violet light and the camera are being used not only to examine the methods and materials used in old pictures but also to detect forgeries. The last chapter, entitled "Frauds and forgeries and how to discover them," makes excellent reading, all the more interesting on account of a recent case in France which was widely reported in this country.

The book is illustrated with good photographs admirably chosen, and the writing, though tending to repetition, is clear, and here and there illumined by words which cannot fail to stir the imagination, as in this analysis of the golden-tinted varnish probably used by Velasquez on the "Rokeby Venus" in the National Gallery:—

"The body of the varnish consisted of sandarac resin dissolved in linseed oil, and the varnish was tinted by the addition, while boiling, of the inner bark of the black plum, saffron, aloes, and dragon's blood."

Edward I. Halliday.

The Diary of Robert Hooke, M.A., M.D., F.R.S., 1672-1680. Edited by Henry W. Robinson and Walter Adams. (Taylor and Francis. 25*s*.)

Hooke's diary for the period 1672-80 is fittingly made accessible to his many admirers on the tercentenary of his birth; and the only regret that can be voiced on the appearance of this extraordinarily interesting and valuable document is that one or other of Hooke's contemporaries did not see to it that posterity should be provided with a portrait of one fit to be counted among the first of those from whom only Newton himself stands apart. But we have here the diary in its plain, human, unannotated, and unbowdlerised nudity; for the editors have wisely resisted all temptation to smother with explanations or to weigh down with comments what is already glutted with facts. The diary could so easily have been drowned in a sea of notes, whereas the avoidance of this offers ample opportunity to specialists in each of the many fields in which Hooke distinguished himself. One of the most pleasing results of the study of the diary is the effective disposing of the legend that Hooke was a miserly recluse, soured with greed for money: another and a very different Hooke rises from these pages, and a surprisingly different Hooke too. Moreover, the diary provides ample confirmation of the views of those who have held that the success of the Royal Society in its earliest years was very largely due to the tireless energy of its Curator of Experiments. It is, of course, impossible in the space of a short review to quote from the vast array of evidence recorded here; but students of this period will now appreciate more than they have already done the significance of the entry for November 12th, 1662, in the Journal Book of the Royal Society: "Sir Robert Moray proposed Mr. Hooke as a curator of experiments to the Society; who being unanimously accepted of, it was ordered, that Mr. Boyle should have the thanks of the Society for dispensing with him for their use; and that Mr. Hooke should come and sit amongst them, and both bring in every day of the meeting three or four experiments of his own, and take care of such others, as should be mentioned to him by the Society."

The illustrations include a reproduction of the title-page of the *Micrographia* as frontispiece, the College of Physicians, Bethlem Hospital, Dr. Busby's Church, the telescope erected by Hooke in the courtyard of Gresham College and two facsimile

pages from the diary. The editors, especially Mr. Henry Robinson, upon whom, as the President of the Royal Society points out in his Foreword, the heavy labours of transcribing Hooke's minute and almost eccentric writing chiefly fell, are to be congratulated on the publication of one of the most important documents in the history of 17th century science.

Return to Philosophy. By C. E. M. JOAD. (Faber and Faber. 7*s.* 6*d.*)

This lively little book is almost entirely in the right direction and very wholesome reading for these times. Mr. Joad sets out to re-establish what we may call the standard, or classical, claim for the supremacy of reason over the surging and often conflicting crowd of passions, instincts, and interests in our nature, and he is able easily to please and convince those who are ready, or already struggling, to pursue the course he recommends. The larger result—reaching those who are in the habit of decrying whatever they like to regard as "highbrow"—will, of course, take much more time than is needed to peruse this little essay. But they will be attracted by its friendly, humorous tone and cannot rebut its serious arguments. It is rather a pointer to larger works and does not pretend to give a full or deeply-thought-out account of the nature of values, of the effect of the doctrine of evolution on the nature of reason, and on the necessary connection between philosophy and science. These, it may be suggested to Mr. Joad, are the three most fundamental topics which his suggestive chapters should lead his readers to pursue further. It is perhaps a pity that he should have spent so much powder and shot on Mr. Aldous Huxley; Bergson would have been much more worthy of his steel. But his object evidently was to find some popular writer to whom he might attach his doctrine and when people once get thinking seriously, as Mr. Joad would have them do, they will naturally go on to the weightier writers, such as Bergson, in whom they will find much of what Mr. Joad has to tell them, linked up with much that would be accepted by thinkers of the other school against whom the attacks of this book are directed. Were there space, it would be interesting to criticise Mr. Joad's attitude towards philosophy in relation to science. This, it appears to this reviewer, is the weaker side of his case. Our ideal must be to return not only to philosophy, as the title invites us, but to "philosophy plus science," as the earlier Greeks practised before us. Mr. Joad is a Platonist rather than an Aristotelian, and Aristotle, being an encyclopædic mind, chiefly interested in biology, must be the guide to bring our errant lowbrows back to reason. The points on which Aristotle, after long and careful thought, felt compelled to depart from Plato, demand at least some weighty deliberation from us. The chief one was, of course, just that point of making philosophy come down from heaven and find its function in rationalising the data of experience. But thoughts such as these are quite subordinate to Mr. Joad's main object, with which one can have nothing but the keenest sympathy. He is particularly good in the vivid defences of individual philosophers with which he adorns and recommends his pages. If we can persuade the lowbrows and free-livers of the present day that there is something heroic, even sporting, in the cultivation of the higher regions of the mind, we shall have won more than half the battle. But they have to think that it *is* heroic and that there *is* a higher and lower in the mind. It is here that Mr. Joad's demonstration is so effective and we wish him all success in his crusade.

F. S. MARVIN.

Tradesman's Entrance. By JOHN BENN. (Philip Allan. 3*s.*6*d.*)

Books on education, into which category this volume falls, too often discourage the possible reader by their physical bulk and their close-set wordy pages. No such mass of paper and ink confronts the reader of the book under review; and, what is more, the attractive presentation is not belied by the contents. Mr. Benn avoids wordiness not because he has little to say, but because he knows what he wants to say.

As has been noted recently in the columns of the daily press, the question in education to-day lies not between ancient and modern learning, but between liberal teaching and vocational teaching. Mr. Benn's case is that liberal teaching serves, in the end, the purpose aimed at by vocational teaching, and that a man well equipped for life is the best fitted for earning a living. And, in the reviewer's opinion, he proves his case. It is, moreover, no mere theoretical proof that he provides, but a practical one derived from personal experience. He himself is a public school and university man who has gone into business with success, and without any technical training except what he received *in the business itself;* and he justly contends that a general education is just the one which enables the neophyte in business to pick up useful ideas rapidly. Not that the technically trained man is of no use—quite the reverse (Mr. Benn is nothing if not broadminded in argument)—but the generally-trained man is the quickest to deal with an emergency.

Arising out of this comes the most amusing section of the book: adventures on the road as a seller of "space." Any one with the remotest conception of canvassing or commercial travelling will realise that emergencies are normal in that walk of life, and Mr. Benn met his ration of them with courage, resource, and a deserved amount of success. Family tradition and family influence helped, no doubt, as the author readily admits; but it is quick wits and an appreciation of the situation that sell the goods.

"Travelling," moreover, is only one branch of business. It is the ability to see a commercial concern as a whole, and to realise that its existence is justified only if it can pay its way and satisfy its servants—from chairman to office-boy—that marks the successful graduate in business: another point where the generally-trained man has the upper hand. Still another sphere, but one of growing importance, is the sphere of leisure; here again, as the author points out, it is obvious that the man of liberal training scores heavily, as he has many resources at his disposal beyond what is actually required for his job.

The pages of this timely volume are enlivened with incident and anecdote; employers, prospective employees, and the parents of prospective employees would all do well to read it; a great deal of profitable advice is here presented in an entertaining and unpretentious form.

The Arachnida. By THEODORE H. SAVORY. (Edward Arnold. 25*s.*)

The Arachnids are less popular than the Insects as objects of study, but, if possible, even more extraordinary in form and function, with the added interest of a more complete geological record.

This important book is a general account of these strange creatures, in the widest sense, that is, it covers the ten existing and seven extinct Orders, and even the sundry groups which are sometimes included in the Class and sometimes left to themselves, such as the tiny Tardigrada, seldom more than

1 mm. in length, among whom occurs a species found both in the Arctic and Antarctic, a very rare instance of bipolarity; also those queer creatures the Pycnogonida, the so-called No-body Crabs, real Tom Noddies, with only enough body to hold together the legs, in which are situated the vital organs; and also the Linguatulidae, internal parasites in some vertebrates.

The dominant Order, of course, are the Spiders, which have been more studied than the other groups, as they are so abundant and provide such a mass of interesting food for observation in their queer matrimonial customs and their power of spinning. The silk of Spiders is a complex albuminoid protein, homologous with their venom, with remarkable physical properties. A thread .01 cm. in diameter will carry a load of over 80 grams without breaking, and will stretch by 20 per cent. of its original length. There are 14 distinct uses to which the creatures put their silk, and it is instructive that the silk glands have originated independently in each group. The author, who studs his work with striking passages, writes in defence of the Spider, whose reputation is not unspotted, "if goddesses, saints, and kings have found cause to be thankful for its existence, humbler mortals may well find in the study of Spiders some help in bearing those trials which are the common lot."

Spiders have been found floating at 10,000 ft., as far north as Lat. 84° N., in Greenland. On Everest jumping Spiders were found at 22,000 ft., "in the proud position of being the highest permanent inhabitants of the world." Other Arachnida too have struck the imagination of the ancients, for they have elevated to a seat in the zodiac the humble Scorpion, which has preserved its form unchanged from the Carboniferous Period. The 300 or so known species are confined to the tropics, for which we need not exaggerate our thanks, as the power of their venom has been greatly overrated. The author makes somewhat light of the venom of the Arachnida, and suggests that much of the harm should probably be ascribed to concomitant septicæmia; still, that would hardly account for the terrible suffering recorded so vividly by Vambéry, who was stung by a Scorpion in Turkestan.

The other Orders are no less remarkable, though less numerous and, in many cases, less known. The Xiphosura include *Limulus*, the King Crab, known to most visitors to Aquaria, who looks more like a Crustacean, is the only marine, gill-breathing Arachnid, and survivor of a highly primitive type. Then there are the so-called Whip Scorpions, the Pedipalpi, which have a strangely discontinuous distribution, and the Palpigradi. These tiny, delicate, defenceless creatures, that have never evolved eyes, have survived as a type from the Palæozoic.

More extraordinary are the Ricinulei. In 1838 a specimen was found in West Africa. To-day, ninety-seven years later, there are thirteen existing and six fossil species known, yet so scarce are they that of the extant forms only thirty-two specimens were in existence in the collections of the world when the book was written. Yet these fragile, evasive, scarce little animals too have come down to us almost unchanged from the Carboniferous Period, in deposits of which age they were detected just one year before their discovery as living forms.

The Solifugae, the so-called Whip Scorpions, are dwellers in the desert, who come out at night to hunt. Mr. Savory tells us that they have the most formidable jaws in the animal kingdom for their size, and they are the very monsters of their world, the "personification of speed, fury, and sudden death."

Then there are the Opiliones, the Harvestmen, familiar to readers of *Discovery* from a recent article by the same author, who calls them the jesters of the Arachnida, and suggests that Evolution must have had a sense of humour to have produced such odd creatures.

The last recent Order are the Acari, the Mites and Ticks, a degenerate yet successful type, for there are already known some 6,000 species, and they are practically ubiquitous.

It is remarkable that such fragile creatures as the Arachnida should be so commonly preserved as fossils, for the Solifugae and Opiliones also come down from the Carboniferous, and there are fifteen kinds of Palæozoic Spiders known, while Mites existed in the Devonian, and as for the Scorpions, they were the pioneers of air-breathing, as far back as the Silurian. The fossil record has afforded material for much discussion upon the origin and mutual relationship between the Arachnida and Crustacea: there is condiserable diversity in detail, but it is generally agreed that these two Classes, with the Insecta, all derive from a pre-Cambrian vermiform ancestor allied to *Peripatus*.

The author gives much interesting information on the behaviour of the Arachnida. All are carnivorous, and most of them spend long periods waiting for their prey, as living traps. He discusses what we might call their psychology. Their actions are instinctive, irresistible, and irrational. They have no mind. Amongst other material, astonishing to the layman, is included the extraordinary story of *Gibocellum*, described in 1875 by Dr. A. Strecker, as an aberrant Arachnid, the true position of which was not detected until 1904, by Sørensen, six years after Strecker's death. This subject of three papers, one of which ran to 52 pages, with four plates and a description of the microscopic structure of the creature, was never anything else than a hoax which never existed outside the author's brain.

As the result of his study of the Arachnida, Mr. Savory has come to the conclusion that the action of Evolution is spasmodic, for between the seventeen Orders there are no connecting links, a fact which he takes as proof against the possibility of Evolution acting by slow, successive changes. He discusses also the repulsion which most Arachnids inspire in mankind, but here it is not always possible for the layman to agree, when he states, for instance, that the dread of a Spider or a Solifuge is due to the speed of its movement, and claims as complete proof "that slow-moving objects do not produce that fear." But this is a small cavil at a work of such importance and value.

The book is admirably produced. The type is clear, and the numerous illustrations are excellent. To the naturalist it is a stimulating mine, to the zoologist a most valuable work of reference.

MALCOLM BURR.

From Galileo to Cosmic Rays. By HARVEY BRACE LEMON, Ph.D. (University of Chicago Press & Cambridge University Press. 17*s.* 6*d.*; with stereoscope, 22*s.* 6*d.*)

The sub-title of this popular work explains that it is a "New Look at Physics"; and, since the book is enclosed, at the purchaser's option, in a box fitted with a stereoscope to enable readers to appreciate properly the various stereographic illustrations scattered through its pages, there is about the production a whole atmosphere of a "New Deal for the Scientific Layman," intensified by the many amusing drawings that are rightly described as "gay" and "modern." Many would doubt whether this kind of thing can be done with the subject matter of science: but it is undeniably done here, and well done too. Indeed, it ought to be said that, while a certain apparently

permanent *Ballyhoo* cartoon may have acquainted us *ad nauseam* with the standard joke about American bathrooms, Professor Lemon completely gets away on p. 258 with a scientific adaptation—and that without becoming commonplace either. Further, the " blurb " in a " Note to the Curious " advises thus: " Don't be intimidated by the word *physics*. This book is different. It isn't written *down* for popular consumption. It is written *up* to the level of the intellectually curious adult who has always wanted to know more about the marvels of the world we live in." Whatever may be the exact significance of the " *up* " and " *down* " used here or, indeed, whether these words have any meaning at all in this context, the author rises far above this trivial advertising patter : and he deserves praise for having produced what many writers and critics would have thought impossible, namely, a popular work on these " gay " lines that is at the same time thoroughly satisfactory in other ways, in its manner and method, and a piece of solid first-rate scholarship. The contents cover the whole range of physics, mechanics, heat, electricity and magnetism, atomic physics, energy and radiation : the text runs to 450 pages, there are 100 plates and a profusion of sketches and " gay " drawings, while throughout it is well and accurately written. It can be recommended to the general reader as well adapted to his special needs.

For all that, this is the sort of thing that can be done once—on the strict understanding that it creates no precedent.

Darwinism and its Critics. By Sir Arthur Keith. (Watts. 1*s*.)

The popular philosophical storms which rage in the background of religion and science have not yet settled down. Especially is this true of biological theories. The amount of *feeling* expended on the issues of Biology is in direct proportion to the importance of the theories advanced by that science and to the nearness with which they approach the everyday life of man, but one can imagine that the " man of science," who fundamentally is uninterested in the results of his speculations in other spheres, must be a little tired at the unabated rumpus which accompanies his progressive leaps towards more complete knowledge.

It comes with a shock of surprise to those whose " world-picture " has been formed since the war that people do feel so strongly about the issue between Evolution and Special Creation, which is the particular biological problem with which this book deals. But it is a shock which has good results. There is none of the old dialectical fervour about religion and science among the present-day young—for who has the time now to find out whether they should be for or against quantum physics, or whether a dynamic or static religion is more adequate to meet the needs of society and of the individual ? It is good therefore to be plunged by Sir Arthur Keith's book into a scintillating duel between the two protagonists on the stage of " Life," at a level which the layman appreciates.

That sums up the value and position of the book. It is interesting controversy and nothing more. Sir Arthur is almost " racy " in his condemnation of Sir Ambrose Fleming. But the publishers are optimistic in asserting that " it is offered in the hope that it will counteract the threatened propaganda in the defence of the doctrine of Special Creation as opposed to the scientific theory of Evolution." All the book will do will be to make people realise the controversial prowess of Sir Arthur Keith and make them wonder at the fact that a scientific theory can have adherents no less fervent than the defenders of some religious dogma. There is no doubt whatever that the book is primarily concerned to defend the Evolutionists—it is secondary that they must be defended by the defence of Evolution. The publishers are wrong too in their implied denunciation of the views of the Special Creationists as propagandist and their implied praise of the Evolutionists' views as scientific, for Sir Arthur, no less than Sir Ambrose, has written a propagandist pamphlet, and he would be the first to admit that he had.

What Sir Arthur Keith does is to examine all the arguments of Sir Ambrose in turn and then go on to the arguments of the other entrants into the controversial lists. He succeeds in vindicating the Evolutionists' position, but adds nothing to scholarship. He trounces these particular arguments of the Special Creationists, but leaves the outside enquirer unsatisfied.

The Cathedrals of Normandy. By Jocelyn Perkins. (Methuen. 8*s*. 6*d*.)

No one is better qualified than the Sacrist of Westminster Abbey to deal with the history and art of a great ecclesiastical building ; and in this, Dr. Jocelyn Perkins's latest volume, we find what we have a right to expect : a scholarly and sympathetic treatment of the half-dozen great Cathedrals of Normandy. The subject is dealt with in its strictest sense : only those churches which are cathedrals to-day are included, and we must expect no description of the great churches of Caen, of the abbey of Mont-Saint-Michel, which the " foolish Couësnon," as the Bretons say, has included in Normandy. But of description of the actual cathedrals we are given full ration ; not a detail is neglected, historical or artistic. And the system of dividing each description into two parts, one general, the other a detailed guide to the fabric, is an excellent one for those who have time for leisured study.

This is emphatically not a book for the casual traveller, who must be content with the guide-books of which Dr. Perkins speaks a trifle slightingly (after all they do not claim to be more than pointers, showing the uninitiated the way to go) ; but the real lover of Normandy, visiting that delectable province for the second or third time, will revel in this scholarly book, which has obviously been a labour of love.

Ridge Way Country. By H. W. Timperley. (Dent. 6*s*.)

Very little escapes Mr. Timperley's observant eye. His " Shropshire Book " showed us how sympathetically he can portray the rural scene ; and whether it be the landscape, the native trees and flowers, or the peculiarities of local styles in building, his comments are sagacious and discerning.

The author explains that, in its broadest meaning, the name " Ridge Way Country " stands for all those parts of England which are traversed by our oldest roads—the ancient ways along the hills ; hence, the ridge ways. This book, however, is confined to the downs which carry the great Ridge Way through that part of its course which is the long curve to the south-west, from Blowingstone Hill in Berkshire to close by Tan Hill, overlooking Pewsey Vale in Wiltshire. An irregular four-sided figure, with Blowingstone Hill, Barbury Camp, Tan Hill, and Chisbury Camp at its corners, covers most of the ground—which,

one might think, is not an area very varied in its features ; but Mr. Timperley shows how variety in the downland scene is not a matter of sudden contrasts, but is what he describes as " the more subtle changefulness that develops into variations on a theme, instead of falling into a series of glimpses of the picturesque."

Mr. Timperley rightly urges the use of local materials in rural building. In the village of Aldbourne—a few miles off the main Cirencester-Newbury road—all the natural downland materials are to be found : flint, chalk, sarsen stone and thatch ; and with them are brick and tile, used in a way that seldom makes them seem out of place.

Here and there, however, Mr. Timperley saw a slate roof, which he thought certainly out of place, however cheap it may be in cost and however effective in use. Most people will agree that a slate roof is really appropriate only on a stone building, and then only when hand-made Welsh slates are used. As Mr. Timperley says, there is no reason for being sentimentally prejudiced against the bringing of untraditional building materials into a district, whether they are of artificial origin or were formerly kept out by the difficulty of moving them about the country, if the new materials blend with the old, stand the test of wear and do not degrade the building crafts ; but they should be such that, with the weathering of not too long a time, they will blend with the old. No one could honestly claim this quality for smooth industrial slates among beautifully weathered downland roofs.

The proper blending of local and imported materials is a lesson which the builder is slow to learn, and one which the speculative builder in particular rarely even bothers to learn. It seems a pity. Good work is now being done, however, by the local architectural advisory panels which have been established in many parts of the country under the auspices of the Council for the Preservation of Rural England ; these committees are ready to give advice on the proper use of materials, and on house designs which are suited to their surroundings. It is to be hoped that builders will be disposed to seek such advice, for the modern builder too often lacks the inituitive taste and judgment associated with the craftsmen of other days.

The Lordship of the Isles. By I. F. GRANT. (Moray Press. 21s.)

Miss Grant had already discovered the interest of a " tour with an object," but in preparing for her latest book, *The Lordship of the Isles*, she has, she admits, experienced much more difficulty in tacking her information connectedly on to her itinerary than she did in her former book. This is natural. In *The Tracks of Montrose* she was dealing chiefly with one man and the limit of his life ; in the present volume her period extends over more than a thousand years and the places she visited are often connected with several incidents and legends varying greatly in point of time. Miss Grant has done excellent work in overcoming her difficulties, but we cannot help wondering whether much has been gained by creating them.

" This book " (Miss Grant writes in her preface) " does not claim to be a piece of scholarly research. I have forsworn the the writing of serious history for ever." In spite of this disclaimer we are delighted to find in perusing her interesting and entertaining pages that she has been unable to subdue her earlier training. She is, in fact, much more of a historian than a guide-book-gossip-monger. She does not lead her reader down the flowery paths of legend as if they were the paved highways of fact. Better still she has the *true* historian's habit of stating her authorities. (Would that this habit were more often cultivated by those who profess what Miss Grant forswears.) We do not desire to dissuade Miss Grant from spending pleasant holidays with " Williamina " and later giving us the benefit of her research, but we do feel that she can spare such details as : " a good place to stay at . . . there the inner man is exquisitely ministered to," " an unfortunate Bentley which we met had to back obsequiously before the battered ' Williamina ' for about half a mile," or " most of the way as far as Ardrishaig is pretty, though there are some nasty corners," etc. There are already more than sufficient writers who must pad their books with this sort of stuff ; Miss Grant is not one of them.

The ancient Lordship covered ground which to-day has few rivals in beauty or romance, a sea-bound country of mountain and glen ; its very names, from Benbecula in the Hebrides to Islay and Kintyre in the South, Iona, Ardtornish, Kilbride (to speak but a few of them), are music on the tongue. It is a land of saints and martyrs, of grim and bloody story and sorrowful tales of love.

Miss Grant has steeped herself in its history and legend and we can heartily recommend her book, not only to those who are lucky enough to spend a summer amidst the beauties of the place itself, but to all who wish to know something of the lonely, often misunderstood, Gael, whose art and spirit have yet done so much to enrich the life of the world.

H. M. ANDERSON.

A Dictionary of Modern American Usage. By H. W. HORWILL. (Oxford University Press. 7s. 6d.)

Here is an uncritical companion to Fowler's *Modern English Usage*, but none the less useful because it states facts instead of giving instructions. The danger in dealing with American literature lies, for an Englishman, in the misinterpretation of words that differ not in form but in meaning—sometimes slightly, sometimes profoundly—and Mr. Horwill provides a helpful guide among these perilous pitfalls. Interesting, too, is the system of indicating by signs those words that have become partially or completely naturalised in England. Some of these are now so familiar to us here that the news of their origin comes as a surprise. Salutary as well as informative reading is here provided for the English man of letters.

A Nematode Bibliography (*see p.* 267).

BAYLIS, H. A. : *A Manual of Helminthology, Medical and Veterinary.* Baillière, Tindall & Cox. London, 1929.

BLACKLOCK, D. B. & SOUTHWELL, R. : *A Guide to Human Parasitology.* London, 1931. H. K. Lewis.

BRUMPT, E. : *Précis de Parasitologie.* Paris, 1927. Masson.

CAMERON, T. W. M. : *The Internal Parasites of Domestic Animals : A Manual for Veterinary Surgeons.* London, 1934. A. & C. Black.

FIEBIGER, J. : *Tierische Parasiten.* Berlin & Wien. Urban & Schwarzenberg.

GOODEY, T. : *Plant Parasitic Nematodes.* London, 1933. Methuen.

HERTWIG, R. : *Lehrbuch der Zoologie.* Jena, 1919. G. Fischer.

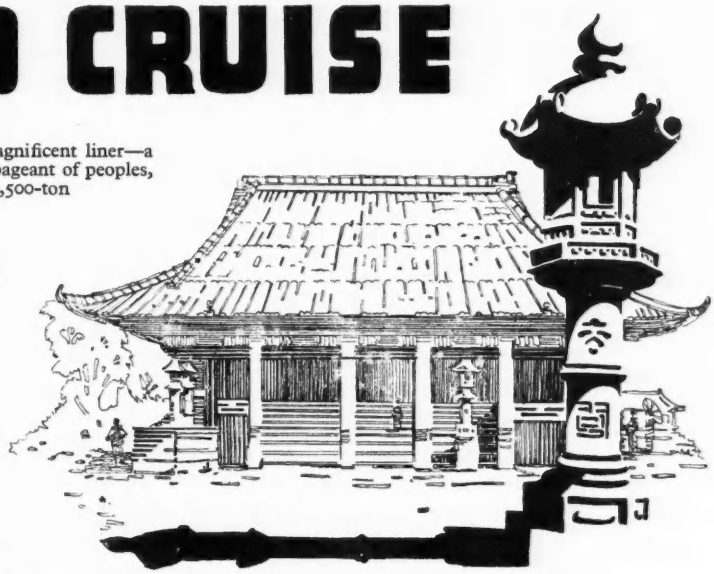
MÖNNIG, H. O. : *Veterinary Helminthology & Parasitology.* London, 1934. Baillière, Tindall & Cox.

RAILLIET, E. A. : *Traité de Zoologie Médicale et Agricole.* Paris, 1895. Asselin et Houzeau.

WORLD CRUISE

Round the globe with the world's most magnificent liner—a fascinating voyage of unceasing interest—a pageant of peoples, ports, places and nations by the new 42,500-ton

Empress of Britain



Biggest ship girdling the globe. Specially designed for cruising, the "EMPRESS OF BRITAIN" has large airy staterooms, a full-size tennis court, squash racquets court, Olympian swimming pool, palatial public rooms decorated by artists of international repute, ample deck space, superlative cuisine and service.

World Cruise itinerary will include EGYPT, INDIA, CEYLON, the STRAITS SETTLEMENTS, SIAM, JAVA, BALI, CHINA, JAPAN, HONOLULU, HOLLYWOOD, PANAMA, NEW YORK, ETC., ETC.

First class only. Limited membership.
From Monaco, January 23rd, 1936.
Minimum Rate : 422 Guineas.
Write for further particulars.

SEVEN SEAS CRUISE

A novel and attractive cruise taking you in warmth and sunshine to the colourful coasts of seven sunny seas—the MEDITERRANEAN, the ÆGEAN and RED SEAS, INDIAN OCEAN, SOUTH ATLANTIC, CARIBBEAN SEA and the NORTH ATLANTIC. For this delightful 91 days' voyage your ship is the luxurious 22,000-ton cruising liner,

EMPRESS OF AUSTRALIA

The "Dream Ship of Cruises" that has many times girdled the globe. Large airy staterooms, Pompeiian swimming pool (and an outdoor pool), gymnasium, ballroom, etc. Book now for this delightful voyage of 22,000 miles, visiting 23 ports in 4 continents.

First class only. Limited membership.
From Monaco, February 8th, 1936
Minimum Rate : 265 Guineas.
Write for further particulars.

NAPLES.
ATHENS.
HAIFA.
SUEZ.
MOMBASA.
ZANZIBAR.
DAR-ES-SALAAM.
LOURENCO MARQUES.
CAPETOWN.
BUENOS AIRES.
RIO DE JANEIRO.
TRINIDAD.
JAMAICA.
NEW YORK, etc.

Canadian Pacific

WORLD'S GREATEST TRAVEL SYSTEM

62-65, Charing Cross (Trafalgar Square), London, S.W.1.
103, Leadenhall Street, London, E.C.3.
or Local Agents Everywhere.

TRADESMAN'S ENTRANCE

By

JOHN BENN

Late editor of "Discovery."

3s. 6d. net

"A racy and altogether delightful account of the author's experiences in business and his conclusions on many subjects . . . . We strongly recommend all teachers to read it, whether they are concerned with commercial subjects or not." —*Journal of Education.*

"A great deal of good sense is packed into a minimum of space." —*Edinburgh Evening News.*

"Every novitiate in the Temple of Commerce would do well to take to heart the many shrewd hints that he has to give . . . . " —*Times Literary Supplement.*

"Mr. Benn is to be congratulated on putting forward a good deal of commonsense and at the same time being thoroughly entertaining."
—*Chamber of Commerce Journal.*

Philip Allan, 69 Gt. Russell St., London

CHINA JOURNAL

Edited by
ARTHUR De C. SOWERBY
F.R.G.S., F.Z.S.

A Monthly Magazine, dealing with Science, Art, Literature, Travel and Exploration, Engineering, Commerce, and Industry, Shooting and Fishing, the Kennel and Garden in the FAR EAST.

ANNUAL SUBSCRIPTION
£1 · 5 · 0

6, MUSEUM ROAD
SHANGHAI, CHINA

The Hong Kong Naturalist

Edited by G. A. C. HERKLOTS, Ph.D., M.Sc., F L S.

A quarterly journal containing articles on the Natural History, History and Archaeology of Hong Kong and South China

Annual Subscription - 12s. 6d.
Post Free.

Each number, already issued, has included at least one coloured plate besides numerous half-tone and line illustrations.

THE UNIVERSITY, HONG KONG, CHINA

MEMBERSHIP OF

THE MUSEUMS ASSOCIATION

IS OPEN TO ALL PERSONS ENGAGED OR INTERESTED IN THE WORK OF MUSEUMS.

Annual Subscription £1 - 1s.

Full particulars and a specimen copy of THE MUSEUMS JOURNAL, *free on application.*

THE MUSEUMS ASSOCIATION
CHAUCER HOUSE, MALET PLACE, LONDON, W.C. 1

AN OFFER

We shall be glad to send a Specimen Copy of Discovery, at a nominal charge of sixpence, to any friends of readers at home or abroad, who are interested in recent scientific advances and other developments of human knowledge- Address—The Publisher, Discovery, 154, Fleet Street, London, E.C.4.

Founded by **E. Kay Robinson,** 1905.

Edited by **Richard Morse, F.L.S.**

"COUNTRY-SIDE"

is an illustrated magazine devoted entirely to Nature, and is published quarterly at 1/-. Will you examine it at our expense ?

ONE FREE COPY

will be delivered at your door the day after tomorrow if you ask for it by postcard today.

THE EDITOR, "COUNTRY-SIDE,"
8, Glamorgan Road, HAMPTON WICK.

CLASSIFIED ANNOUNCEMENTS

are accepted at 1d. per word (minimum 24 words). Discount allowed for series, particulars on application. Instructions should be sent (with cash) to the Advertisement Manager—

"DISCOVERY," BOUVERIE HOUSE, 154, FLEET STREET, LONDON, E.C.4.

EDUCATIONAL.

NEWTOWN SCHOOL, WATERFORD. A well-equipped modern co-educational school founded by the Society of Friends in 1798. Apply Headmaster.

ST. MARGARET'S, HINDHEAD, SURREY.—Prep. Girls and Pre-prep. Boys. Beautiful grounds. Healthy district. Sound education. Entire charge. Prospectus and particulars on application to the MISSES HARTLAND or CAPT. B. S. HARTLAND, 3rd Batt. Assam Rifles, Kohima, India.

DELICATE APPARATUS NEEDS SKILLED CARE, and delicate, finely balanced boys are not always fit for the rough and tumble of the ordinary school. Parents who are interested in the BETTER WAY of education are invited to write to The Head Tutor, CRANEMOOR, CHRISTCHURCH, HANTS, for details of a Healthy-life Tutorial School designed for the needs of the finer, less robust boys of this generation.

SCHOOL CERT. and ARMY. LATIN taken for former only Quick easy way if Major Shaw, M.C., R.A., Milford-on-sea.

TAUNTON SCHOOL, TAUNTON. Valuable Scholarships are offered annually in June. A number of bursaries are available for the sons of ministers, missionaries and clergy. For all particulars apply to the Head Master.

THE LAURELS, RUGBY. Established 1872. Recognised by the B. of E. Private Boarding School. Graduate Staff. Preparation for University Entrance Examinations. Excellent health and games record. A few scholarships available.

DR. WILLIAMS' School for Girls, Dolgelley, North Wales. Prospectus from Miss E. C. Nightingale, M.A.

CHURCH EDUCATION CORPORATION. Public Schools for Girls: BEDGEBURY PARK, Goudhurst, Kent: Headmistress—Miss Bickersteth, B.A. SANDECOTES SCHOOL, PARKSTONE, Dorset: Headmistress—Miss Harding, B.A. UPLANDS SCHOOL, St. Leonards-on-Sea: Headmistress—Miss Hill, M.A. Scholarships and Exhibitions offered for competition.

ROCKLANDS SCHOOLS, East Cliffs, Hastings. Parents interested in education should apply for new booklet, just issued, giving history and aims of the school with many illustrations. Friends would help by sending one shilling towards cost and postage.

COUNTRY ACCOMMODATION.

BOURNEMOUTH. BRANKSOME DENE HOTEL. Fruitarian and Vegetarian. Delightfully situated in its own grounds. Write for illustrated brochure. Telephone 1104 and 4796.

THE COTSWOLDS. Alpine like scenery. Fine air and views. Excellent accommodation at Prospect House Hotel, Bull's Cross, Stroud, Gloucestershire. Telephone Painswick 63. A.A. recommended.

MIEDERS-IM-STUBAI, Tirol; 3,100 ft up; 10 miles Innsbruck; beautiful Alpine scenery. Excellent cuisine; English spoken and English Library. Lawn Tennis. 7/6d.—8/6d., p.d. Special Arrangements parties. Herr Beck, Hotel Lerchenhof.

MISCELLANEOUS.

DIETING FOR HEALTH. Lady Margaret Fruitarian Hospital, 19a, Red Lion Square. Free to the poor. Wednesdays 5. "DIET CURES" (Residents), Doddington, Kent.

JOHN PEEL TWEEDS—Woven from pure wool of the hardy little Cumberland sheep bred on the hills of the "John Peel" country. Hard wearing, weather resisting, for sports and country wear. Full suit length 35/6, or 10/6 per yard 56 in. wide. Write for patterns. Sole suppliers, S. Redmayne & Sons, Ltd., No. 34, Wigton, Cumberland.

LOCOMOTION, THE INDEPENDENT RAILWAY QUARTERLY, summarises and comments upon railway development in Great Britain, with illustrated articles on past and present conditions. LOCOMOTION provides a readable review which will appeal to everyone interested in railways apart from the mere business of travelling. Annual subscription 2/-; 19, The Drive, Sidcup, Kent

SPECIMENS, plants and animals photographed on your own premises by expert photographer. W. MCWILLIAM, 68, Shakespeare Rd., London, W.7. 'Phone: Ealing 4944.

TYPEWRITING & DUPLICATING. Novels, Plays, Short Stories, etc., 10d. per 1,000 words. Scientific Mss. 1/- per 1,000, carbon copies 2d. per 1,000. Eric Carsley, 49, Newton Street, Newark, Notts.

"ABBREVIA"—using ordinary letters—simplest shorthand. "Magnificent," "Delightful," "Marvellous," "Most easily acquired." ABBREVIA (D), 29 Donald St., Cardiff.

CONTENTS.

	PAGE
Notes of the Month	247
The Norwich Meeting of the British Association	249
Racial Myths and Ethnic Fallacies	252
Scientific Problems and the Fine Arts	258
Lost Tribes of Malaya	262
The Folk Dance and Science	265
The Costly Nematode	266
The Ruins of Quirigua	268
National Trust News	272
Joseph Hooker and the British Association	273
Television and the Future	276
Seeing Land-Waves	279
Book Reviews	280

BROOKLYN BOTANIC GARDEN MEMOIRS.

Volume I: 33 contributions by various authors on genetics, pathology, mycology, physiology, ecology, plant geography, and systematic botany. Price $3.50, plus postage.

Volume II: The vegetation of Long Island. Part I: The vegetation of Montauk, etc. By NORMAN TAYLOR. Pub. 1923. 108 pp. Price $1.00.

Volume III: The vegetation of Mt. Desert Island, Maine, and its environment. By BARRINGTON MOORE and NORMAN TAYLOR 151 pp., 27 text-figures, vegetation map in colours. 10th June, 1927. Price $1.60.

AMERICAN JOURNAL OF BOTANY.

Devoted to all Branches of Botanical Science.

Established 1914. Monthly except August and September. Official Publication of the Botanical Society of America.

Subscription, $7 a year for complete volumes (January to December). Parts of volumes at the single number rate. Volumes 1—21 complete, as available, $170. Single numbers $1.00 each, post free. Prices of odd volumes on request. Foreign postage: 40 cents.

ECOLOGY.

All Forms of Life in Relation to Environment.

Established 1920. Quarterly. Official Publication of the Ecological Society of America. Subscription, $4 a year for complete volumes (January to December). Parts of volumes at the single number rate. Back volumes, as available, $5 each.

Single numbers, $1.25, post free. Foreign postage: 20 cents.

GENETICS.

A Periodical Record of Investigations bearing on Heredity and Variation.

Established 1916. Bi-monthly.

Subscription, $6 a year for complete volumes (January to December). Parts of volumes at the single number rate. Single numbers, $1.25, post free. Back volumes, as available, $7.00 each. Foreign postage: 50 cents.

Orders should be placed with

THE SECRETARY,
BROOKLYN BOTANIC GARDEN,
1000 WASHINGTON AVENUE, BROOKLYN, N.Y., U.S.A.

A Scientific Investment

IT is sometimes said that new inventions displace labour and cause unemployment. The Australian Government has discovered how timber may be produced at a speed hitherto unknown. The commercial application of this has created work for many more people.

What is more, it enables YOU to invest profitably. You may invest £5 now, followed by a subscription of £1 per month (paid quarterly or half-yearly if preferred) until £35 is completed. At a conservative estimate this will bring you about £250 within approximately 12 years.

Any number of £35 units may be purchased.

Write for full particulars to:

The Forestry Pulp & Paper Co. of Australia Ltd.
(Incorporated in Victoria, Australia)

Dept. Dy, Bush House, Aldwych, London, W.C.2

CARNEGIE INSTITUTION OF WASHINGTON

IS a research organization working in many fields. Its monographic publications are placed in the principal libraries of the world. Copies can be purchased at nominal cost.

These publications comprise studies in the following fields:—

ARCHAEOLOGY
ANTHROPOLOGY
ASTRONOMY
BIOLOGY
BOTANY
CHEMISTRY
ECOLOGY
ECONOMICS
EMBRYOLOGY
GENETICS
GEOLOGY
HISTORY
LITERATURE
MATHEMATICS
NUTRITION
PALAEONTOLOGY
PALAEOGRAPHY
PHILOLOGY
PHYSICS
TERRESTRIAL MAGNETISM
ZOOLOGY

Descriptive Lists and Prices may be obtained by addressing:

CARNEGIE INSTITUTION OF WASHINGTON
WASHINGTON, D.C., U.S.A.

Printed in Great Britain by THE PRESS AT COOMBELANDS LTD., Addlestone and London, and published for the Trustees by BENN BROTHERS, LTD., Bouverie House, 154 Fleet Street, E.C.4. 1st September, 1935.

ment

nventions
ployment.
liscovered
d hitherto
n of this
e.

est profit-
wed by a
arterly or
ompleted.
oring you
ears.

urchased.

Australia
Ltd.
on, W.C.2

UTION
ON

in many
ions are
e world.
.

in the

RE
TICS
N
OLOGY
RAPHY
Y

IAL
TISM

obtained by

HINGTON
A.

e Trustees by